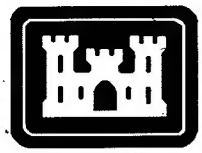


Contract No. DACW29-97-D-0018
Delivery Order 0026

PHASE I REMOTE SENSING MARINE ARCHEOLOGICAL SURVEY OF THE PROPOSED WEST BAY DIVERSION ANCHORAGE AREA, PLAQUEMINES PARISH, LOUISIANA

FINAL REPORT
APRIL 2001

PREPARED FOR:

U.S. Army Corps of Engineers
New Orleans District
P.O. Box 60267
New Orleans, Louisiana 70160-0267

UNCLASSIFIED: DISTRIBUTION IS UNLIMITED

R. CHRISTOPHER GOODWIN & ASSOCIATES, INC.
241 EAST FOURTH STREET, SUITE 100 • FREDERICK, MD 21701

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	April 2001	Final Report/February 13 – 20, 2000

4. TITLE AND SUBTITLE
Phase I Remote Sensing Marine Archeological Survey of the Proposed West Bay Diversion Anchorage Area, Plaquemines Parish, Louisiana

5. FUNDING NUMBERS

6. AUTHORS
Jean B. Pelletier, M.A., Sarah A. Milstead Post, B.A., Carrie E. Sowden, B.S., Larkin A. Post, B.A., and Richard Vidutis, Ph.D.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
R. Christopher Goodwin & Associates, Inc.
241 East Fourth Street, Suite 100
Frederick, MD 21701

8.

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers, New Orleans District
P.O. Box 60267
New Orleans, LA 70160-0267

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVALIABILITY STATEMENT
Unclassified/Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

This report presents the results of a Phase I marine remote sensing survey for the West Bay Diversion Project on the Mississippi River, Plaquemines Parish, Louisiana. These investigations were conducted during February 13 – 20, 2000, by R. Christopher Goodwin & Associates, Inc. on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD). The study was undertaken to assist the USACE-NOD in satisfying its responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended. All aspects of the investigations were completed in accordance with the Scope-of-Work, and the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (Federal Register 48, No 190,1983).

The survey area consists of two areas, of which both lie in the Mississippi River, near Cubits Gap, from Old Quarantine to the Head of Passes. The first area measures approximately 4 mi (6,485 m) long and 500 ft (152 m) wide, and encompassed approximately 244 acres. This area is proposed to be maintained for anchorage. The second area is an area within the limits of the Cut/Diversion and measures approximately 4,600 ft (1,402 m) long and 1,239 ft (378 m) wide, and covered roughly 130.8 acres. The objectives of this study were to identify specific targets within the project area that might represent significant cultural resources, and to provide the USACE-NOD with management recommendations for such resources. These objectives were met with a research design that combined background archival investigations and a marine archeological remote sensing survey.

Archeological investigations consisted of a controlled marine remote sensing survey of approximately 67.0 linear miles of river bottom. This survey utilized a differential global positioning system (DGPS), a digital recording side scan sonar, a recording proton procession magnetometer, a fathometer, and hydrographic navigational computer software. The survey was conducted at a lane spacing of 50 ft (15.24 m) to ensure the greatest detail in coverage. If any historic vessels had been abandoned or destroyed in the survey area, they would have been readily detectable with the remote sensing instruments employed during the survey. One possible vessel was detected, however, it was determined to be modern. The marine remote sensing survey registered a total of 128 individual magnetic anomalies and 25 individual acoustic anomalies. Only six acoustic anomalies correlated with the magnetic anomalies. In total, 22 targets were identified that warranted specific analysis. All were identified either as modern ferrous debris or areas associated with dredging. No further work is required for the West Bay Diversion Project area.

14. SUBJECT TERMS
marine remote sensing survey, West Bay Diversion, Mississippi River, Plaquemines Parish, Cubits Gap, Old Quarantine, Head of Passes

15. NUMBER OF PAGES
140

PRICE CODE

16. SECURITY CLASSIFICATION OF REPORT	17. SECURITY CLASSIFICATION OF THIS PAGE	18. SECURITY CLASSIFICATION OF ABSTRACT	19. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

ACKNOWLEDGEMENTS

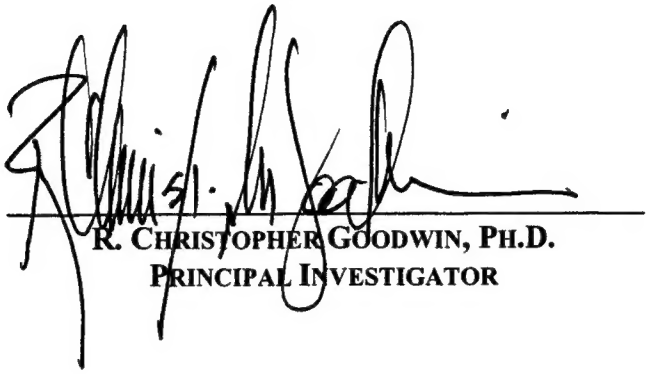
R. Christopher Goodwin & Associates, Inc., would like to acknowledge the numerous individuals and agencies who provided timely assistance and support during archival and archeological investigations for the West Bay Diversion Survey. We would particularly like to thank the U.S. Army Corps of Engineers, New Orleans District's Ms. Joan Exnicios for her generous assistance and expert guidance with the project.

Special thanks also are due to the U.S. Army Corps of Engineers, Venice, Louisiana for their information concerning the survey area. Thanks to the Louisiana Universities Marine Consortium (LUMCON) for the lease of their boat, *R/V Coli*. LUMCON's captain, Mr. Samuel Le Bouef expertly guided the survey vessel during field work operations.

At Goodwin and Associates, Inc., R. Christopher Goodwin, Ph.D., served as Principal Investigator. Jean B. Pelletier, M.A., acted as Project Manager and directed all aspects of the field investigations and data analysis. Richard Vidutis, Ph.D., served as project Historian. Frank Vento, Ph.D., served as contract geologist. Sarah Milstead Post, B.A., assisted in the field investigations and with the remote sensing survey, analysis of data, and with preparation of the report. Larkin Post, B.A., Carrie Sowden, B.S., and Joshua Weller, B.S., assisted with the preparation of the report. Graphics were produced by Barry Warthen, B.A. This report was produced by Sandi Castle and Sharon Little.

PHASE I REMOTE SENSING MARINE ARCHEOLOGICAL SURVEY OF THE PROPOSED WEST BAY DIVERSION ANCHORAGE AREA, PLAQUEMINES PARISH, LOUISIANA

FINAL REPORT



R. CHRISTOPHER GOODWIN, PH.D.
PRINCIPAL INVESTIGATOR

WITH

JEAN B. PELLETIER, M.A., SARAH A. MILSTEAD POST, B.A., CARRIE E. SOWDEN, B.S., LARKIN A. POST, B.A., AND RICHARD VIDUTIS, PH.D.

R. CHRISTOPHER GOODWIN & ASSOCIATES, INC.
241 EAST FOURTH STREET, SUITE 100
FREDERICK, MARYLAND 21701

APRIL 2001

FOR

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

This report presents the results of the Phase I Marine Archeological Remote Sensing Survey for the West Bay Diversion and Anchorage Area in Plaquemines Parish, Louisiana (Figure 1). R. Christopher Goodwin & Associates, Inc. conducted the investigations from February 13 – February 20, 2000, on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD), in support of the proposed disposal of dredge materials in this area in the near future. In keeping with the New Orleans District's mission to preserve, document, and protect significant cultural resources, a magnetic and acoustic remote sensing survey was undertaken to locate potential archeological remains and, in so doing, to assist the USACE-NOD in satisfying its responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended. All aspects of the investigations were completed in full compliance with the Scope-of-Work; with 36 CFR 800, "Protection of Historic Properties;" with the Abandoned Shipwreck Act of 1987 (43 U.S. C. 2101 – 2106); with Abandoned Shipwreck Guidelines, National Park Service; with National Register Bulletins 14, 16, and 20; with 36 CFR 66; and with the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (Federal Register 48, No 190, 1983).

The project area is located from Old Quarantine, near Cubits Gap, to the Head of Passes within the Mississippi River, Louisiana. The survey area consisted of two survey blocks; the Anchorage Area (Block1) and the Cut/Diversion Area (Block 2) (Figure 2). Block 1 is an area with the potential to be maintained for anchorage. It is 5 mi (7,927 m) long and 500 ft (152 m) wide. Block 2 is an area that is connected to Block 1, but is within the limits of the Cut/Diversion.

Block 2 is approximately 4,600ft (1,402 m) long and 1,239 ft (378 m) wide. This survey was conducted along parallel track lines spaced at 50 ft (15 m) intervals. In total, approximately 78.5 linear mi (122.9 km) of river bottom were surveyed. The West Bay Diversion Anchorage Area and Cut/Diversion Area marine remote sensing survey was conducted from the 24 ft research vessel *Coli. Coli* was leased from the Louisiana Universities Marine Consortium (LUMCON). The survey blocks formed by the Anchorage Area and the Cut/Diversion have the following coordinates (Edwin A. Lyon, personal communication November 24, 1999):

Anchorage Area

Point No.	NAD 83 X-Coordinates	NAD 83 Y-Coordinates
1	3,931,937	268,553
2	3,933,811	266,990
3	3,935,352	263,928
4	3,938,029	259,861
5	3,940,406	255,429
6	3,942,389	250,507
7	3,941,689	250,151
8	3,939,369	255,882
9	3,935,766	261,819

Cut/Diversion

Point No.	NAD 83 X-Coordinates	NAD 83 Y-Coordinates
3	3,935,352	263,928
10	3,930,515	264,125
11	3,930,556	265,124
12	3,934,662	264,957

Research Objectives and Design

The objectives of this study were to identify all submerged and visible watercraft and other maritime related cultural resources in the West Bay Diversion project area; whenever possible, to assess the National Register of Historic Places (NRHP) eligibility of identified resources, applying the Criteria for Evaluation (36 CFR 60.4 [a-d]); and, to provide the USACE-NOD with management recommendations for any such resources. These objectives were addressed through a combination of archival research and field survey. The background study and history of the project area were researched through examination of archeological site files for the State of Louisiana, local historical literature files, previous cultural resources investigations conducted in the vicinity of the project area, historic maps, relevant primary map and microfilm records, and secondary literature.

The equipment array used for the West Bay Diversion survey included DGPS, a proton precession marine magnetometer, a side scan sonar, and a fathometer. Data were collected and correlated by a laptop computer using hydrographic survey software. Data were inventoried, post-processed, and analyzed to identify specific targets within the project area that might represent significant submerged cultural resources.

R. Christopher Goodwin, Ph.D., served as Principal Investigator for this project. Jean B. Pelletier, M.A., served as Project Manager, and directed all aspects of data collection and its subsequent analysis. Captain Samuel LeBoeuf operated the survey vessel.

Organization of the Report

This report develops the natural and historical contexts of the project area as the basis for analysis and interpretation. The geological and prehistoric settings of the project area are discussed in Chapter II. Chapter III places the project area within its historic context. Chapter IV reviews previous investigations in the vicinity of the project area, and identifies recorded shipwrecks in the vicinity. Chapter V reviews research methods and sources used during archival and background investigation, and the instrumentation and methods employed during field survey and analysis. The results and analyses of the remote sensing survey are examined in Chapter VI. A summary of the study and management recommendations are provided in Chapter VII.

Appendix I contains the original Scope-of-Work for this project. Appendix II contains resumes of key project personnel.

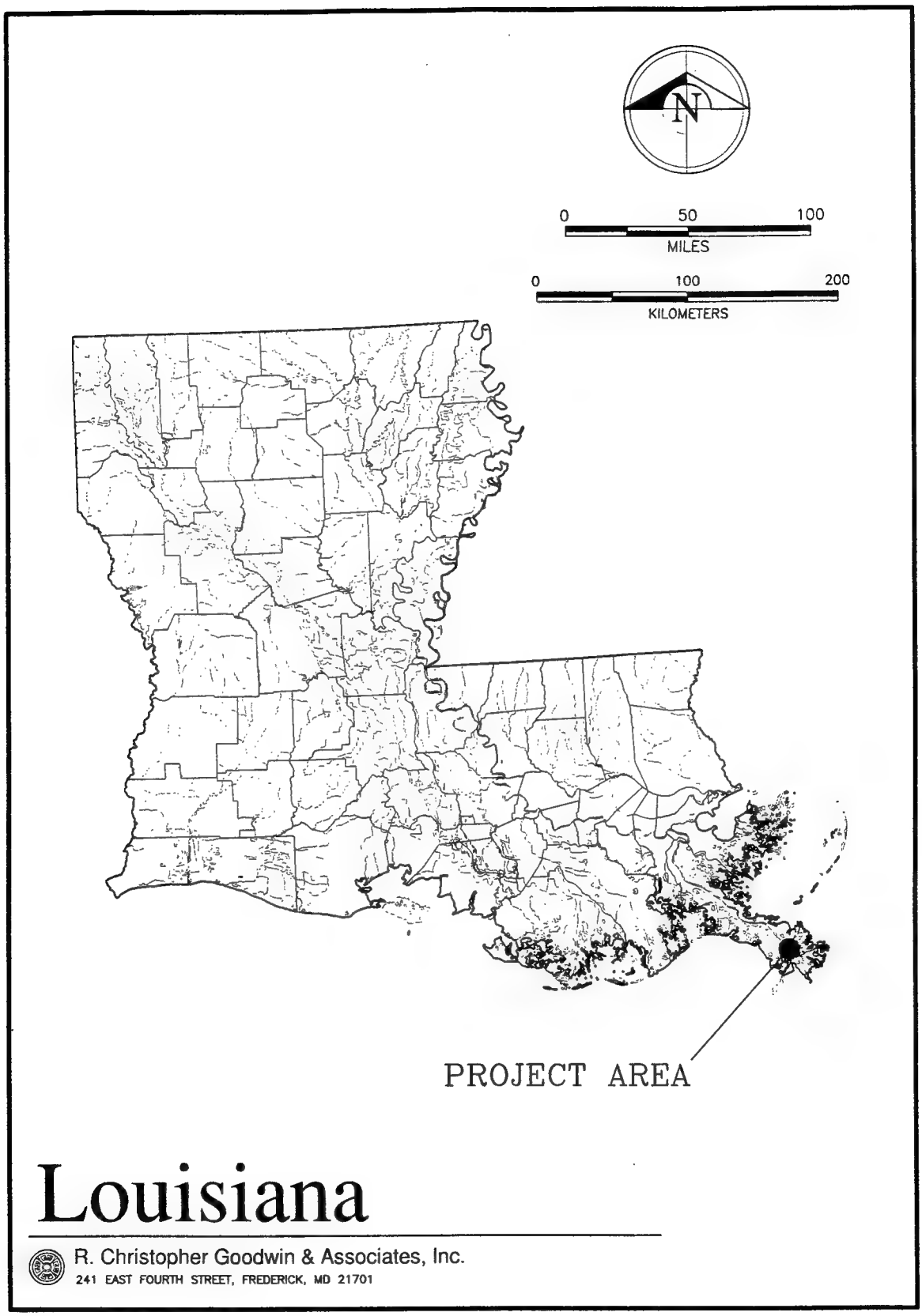
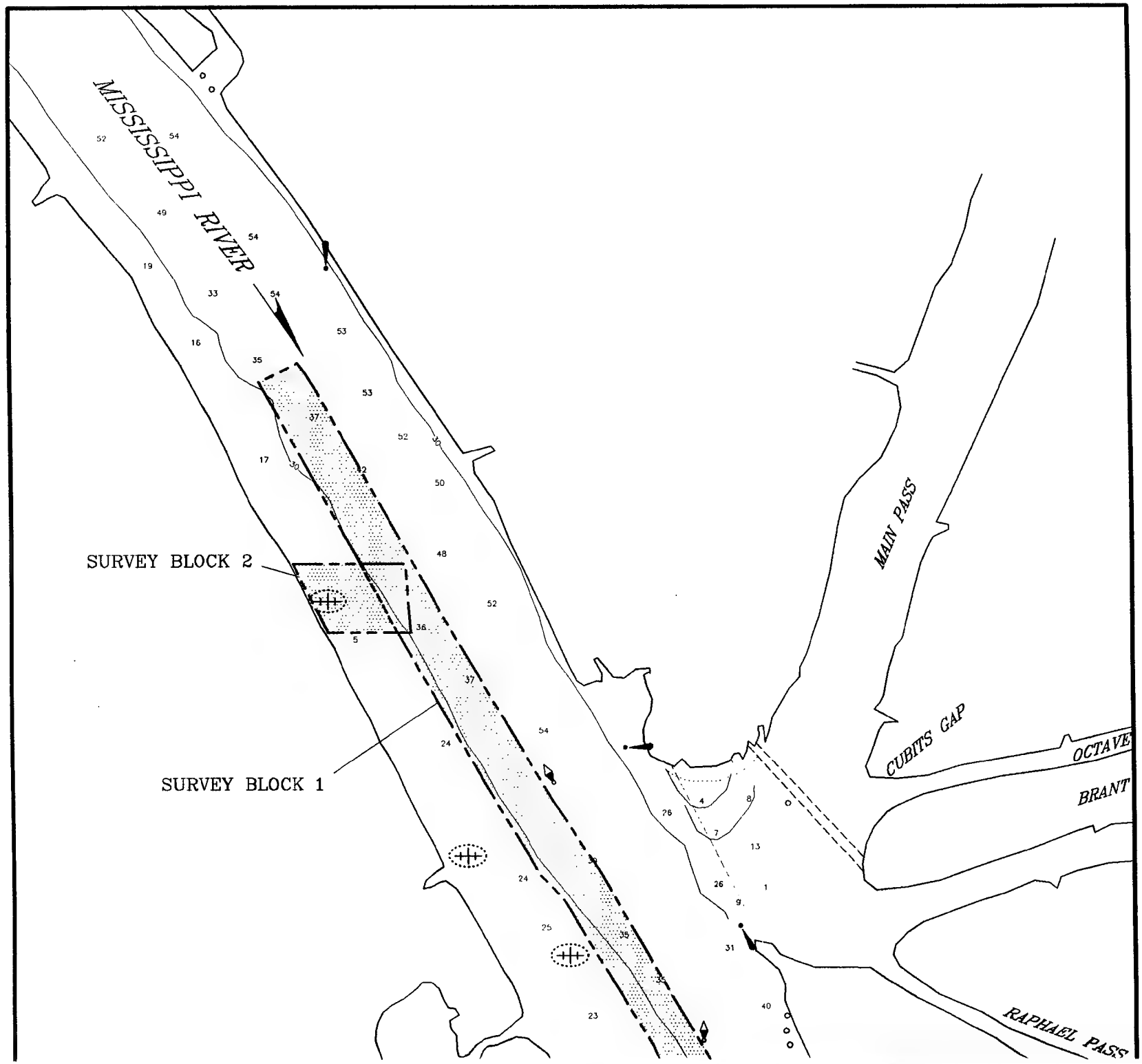


Figure 1. Map of Louisiana showing location of project.


MISSISSIPPI RIVER
SURVEY BLOCK 2
SURVEY BLOCK 1
MAIN PASS
CUBITS GAP
OCTAVE
BRANT
RAPHAEL PASS

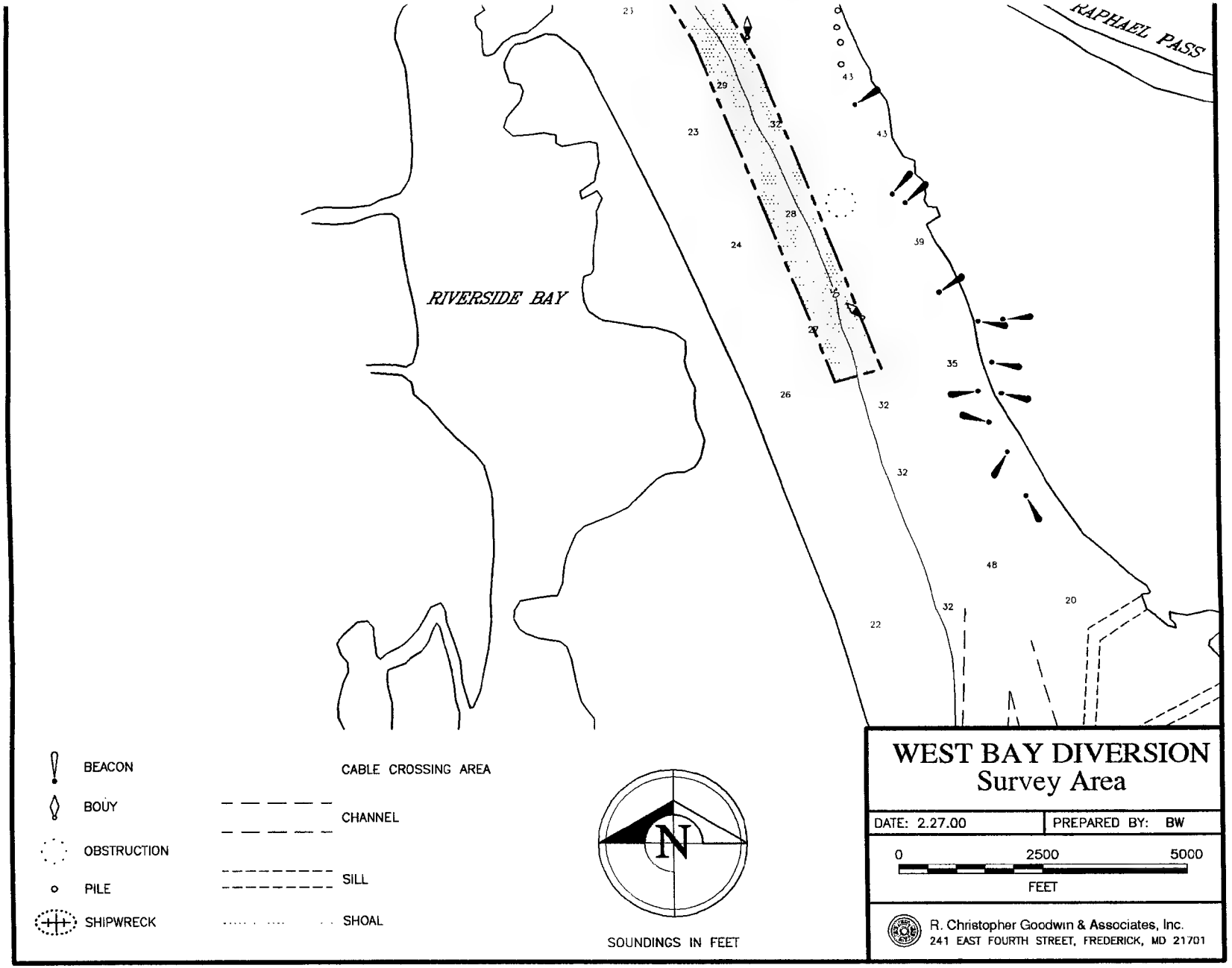


Figure 2. West Bay Diversion Project, West Bay Survey Area, Louisiana.

CHAPTER II

NATURAL SETTING

Purpose and Scope

This portion of the report focuses on the geologic setting and geomorphic processes of the modern, active (Balize) delta of the Mississippi River as related to the development of the West Bay Diversion Area. It provides insight into aspects of physiography, sedimentation, and stratigraphy that should be helpful in understanding the natural history context of possible cultural resources in the area.

Geographic and Physiographic Settings

The active Mississippi River delta, where the stream discharges into the Gulf of Mexico, lies at the extreme southeastern tip of the Mississippi River deltaic plain of southeastern Louisiana. It is defined by the extent of deltaic distributaries, which have been active in historic times. These lie southeast of the town of Venice in Plaquemines Parish, LA, and include six channels (passes). The three farthest upstream passes, Baptiste Collette, Grand-Tiger, and Main Pass, are minor channels and are largely inactive as far as delta growth is concerned. The larger and active channels are farthest downstream and include Southwest and South Passes and Pass a Loutre (plus several branches of the latter). These three major passes bifurcate at a point known as Head of Passes (HOP) just downstream from the settlement of Pilottown, LA, located just below the project area. The pattern of bifurcation is the origin of the term "birdfoot delta" that often is used to describe the modern delta and differentiate it from other types of deltaic plains (Fisk 1961).

It generally is stated in the literature that the three major passes handle about 80 per cent of the total river discharge; however, division of flow between passes has been variously estimated. Welder (1959) stated that Southwest Pass carries 29 per cent of the total discharge, whereas Benson and Boland (1986) stated that it carries 31.5 per cent of the discharge. These differences are not considered significant or indicative of a trend. Rather they probably reflect differences in measurement techniques. To place the values in context, Coleman and Roberts (1991) stated that the average discharge of the river is 12,063 cu m/sec (142,000 cu ft/sec) and that its maximum discharge has been recorded at 56,637 cu m/sec (2,000,000 cu ft/sec). He also stated that the average annual sediment load of the river is about 31,752,000 kg (700,000,000 tons).

Physiographically, Southwest Pass is a narrow neck of land generally less than 4.8 km (3.0 mi) wide that projects seaward from the main deltaic plain landmass. In a natural state, the pass was bordered by very narrow natural levee ridges only a few hundred meters wide and less than 1 m (3.0 ft) above sea level. The natural levees decreased slightly in width and height in a downstream direction and were bordered by areas of fresh to intermediate intratidal marsh. According to O'Neil (1949), the marshes were vegetated with alligator grass (*Alternanthera philoxeroides*) and water hyacinth (*Eichornia crassipes*), with lesser amounts of cattail (*Typha spp.*), roseau cane (*Phragmites communis*), fresh marsh three-cornered grass (*Scirpus americanus*), dog-tooth grass (*Panicum repens*), yellow cutgrass (*Zizaniopsis*

miliacea), oyster grass (*Spartina alterniflora*), and duck potato (*Sagittaria latifolia*). Most of the natural levee ridges also support marsh grasses with only the higher portions having stands of willow (*Salix nigra*), hackberry (*Celtis laevigata*), and cottonwood (*Populus deltoides*). More recently, Chabreck and Linscombe (1978) characterized the marshes as including wiregrass (*Spartina patens*), deer pea (*Vigna repens*), bulltongue (*Sagittaria sp.*), wild millet (*Echinochioa walteri*), bullwhip (*Scirpus californicus*), and sawgrass (*Cladium jamaicense*). The more recent assemblage reflects an overall trend toward higher salinity which may be indicative of the deterioration of the wetlands due to subsidence (see discussion below).

Most of the marshes along Southwest Pass are associated with two small crevasses that formed small lobes or splays (see later discussion). The larger of the two formed on the left descending bank near river mile 5 below HOP and is marked by Joseph Bayou (Russell 1936). The smaller of the two formed on the right descending bank near river mile 9 below HOP and is marked by Double Bayou. Joseph Bayou was described as being 3.4 m (11 ft) deep, 30.5 m (100 ft) wide, and about 3.2 km (2 mi) long in 1897. It was closed by a dam (stone jetty) in 1906 and by 1936, it was only 3.0 m (10 ft) deep and 15.2 m (50 ft) wide.

The West Bay Diversion Project area is located between Old Quarantine and Head of Passes in the Mississippi River. The landscape is dominated by artificial structures such as a pilot's station, numerous navigation lights, and production platforms, tank farms, and piers and docks related to petroleum production. While the normal tidal range along the West Bay Diversion Area is only 39.6 cm (1.3 ft), the entire area frequently is submerged during storm tides accompanying tropical storms and hurricanes. All structures must be able to withstand occasional inundation to a depth of several meters since there are no flood-control levees or floodwalls in this part of the delta. During severe hurricanes, wave heights of over 20 m (65 ft) have been recorded on offshore platforms in deep water around the delta's perimeter, but these heights decreased to 3 to 5 m (10 to 15 ft) in water depths of 18 m (60 ft) or less (Bea and Audibert 1980). Storm surges of this magnitude could affect the immediate Southwest Pass area.

During times of high water due to upstream flooding on the river, the stage at HOP has reached an elevation of 1.58 m (5.2 ft) (NGVD). However, the water surface slopes to Gulf level at the mouth of the pass. At such times, the entire delta is flooded as it is during storm surges. At low water, all of the study area is affected by tides and a salt wedge crosses the bar and moves upstream to a distance of 241 km (150 mi) or more.

General Geologic Setting

The West Bay Diversion Area and the modern (Balize) delta are situated in the Gulf segment of the Coastal Plain Province of North America. The overall Mississippi deltaic plain is a broad, low-lying tract of alluvial land entirely of Holocene age and nowhere more than a few thousand years old. Geologically, it overlies the northern portion of the east-west trending Gulf Basin, a deep structural trough where the continental crust (Paleozoic basement rocks) has been depressed and where mostly unconsolidated sediments of fluvial, estuarine, and marine origin have accumulated to a thickness of tens of thousands of meters. The northern flank of the Gulf Basin is characterized by prevailing subsidence, east-west trending zones of active faults, and the diapiric intrusion of salt to form piercement-type salt domes (Murray 1961).

More specifically, the Mississippi River deltaic plain is the surface manifestation of a relatively thin, seaward thickening prism of Holocene deltaic and shallow marine deposits that overlies Pleistocene deposits of similar origin and still older ones with depth (Kolb and VanLopik 1958). The Southwest Pass

area lies where the prism begins to thicken sharply near the edge of the continental shelf. Fisk and McFarlan, Jr. (1955) indicated that the top of Pleistocene-age deposits occurs at a depth of about 198 m (650 ft) near HOP but may be a deep at about 305 m (1,000 ft) at the tip of the pass.

The prism of Holocene deltaic deposits represents a series of distinctive onlapping sedimentary cycles initiated by upstream diversions of river flow, each cycle being the correlative of a discrete delta complex. Each cycle involves sediments laid down in multiple environments ranging from freshwater to saline in the dynamic zone of interaction where the river emptied into the Gulf. The cumulative result of multiple cycles has been the net buildup and seaward buildout of the deltaic plain. The Balize complex or birdfoot delta (also referred to as the Plaquemines-Modern complex) is the most recent of the complexes (Frazier 1967). This complex is the only one to have formed in relatively deep water: all the others are truly shallow-water complexes with distributaries that form a "horsetail" pattern.

Each delta complex in turn involves a series of delta lobes, a lobe being defined as that portion of a complex that formed during a relatively short period of time (decades to centuries) and that can be attributed to a single or discrete set of deltaic distributaries. Each lobe involves a characteristic pattern of sedimentary facies representing discrete environments of deposition such as natural levee, intratidal wetland, and bay-sound. In terms of its depositional environments and sedimentary architecture and because of its youthful state of development and brief history, the Balize complex (birdfoot delta) can be considered as a single lobe. Forming the flesh on the skeletal framework of major distributaries (passes) of the lobe is a series of lenticular sedimentary masses (Coleman and Gagliano 1964). These masses, analogous in surficial landforms and environments to mini lobes of short duration, are crevasse systems dating from the historic period. The crevasse systems formed in shallow bays (bay fills) between or adjacent to major distributaries and extended themselves seaward through a system of radial, bifurcating channels similar in planform to the veins of a leaf. Along Southwest Pass, the Joseph and Double Bayou systems are historic period crevasses.

Because of the prevailing influence of subsidence and sea level rise during the late Holocene (including the historic period), each delta lobe as well as crevasse system has experienced a constructional or progradational phase in which fluvial processes dominate, and a subsequent destructional or transgressive phase in which marine processes become progressively more dominant. Crevasse systems form initially as breaks in major distributary natural levees during flood stages, gradually increase in flow through successive floods, reach a peak of maximum discharge and deposition, wane, and become inactive. Eventually the dead systems are inundated, reverting to bay environments, thus completing the sedimentary cycle.

Basic Geologic Controls

Two processes--subsidence and sea level rise--are the paramount controls to be considered in virtually all aspects of the geomorphology and geoarcheology of the Mississippi River deltaic plain. For more than a century, it has been known that deltaic plain landforms, as well as the structures and facilities located on them, are sinking at a rapid rate not only in geological time frames but human time frames as well. Geologically, subsidence can be simply defined as the relative lowering of the land surface with respect to sea level and may involve five basic factors or natural processes (Kolb and VanLopik 1958). These include: a) true or actual sea level rise, b) sinking of the basement (Paleozoic) rocks due to crustal processes, c) tectonic activity such as faulting, d) consolidation of the thousands of meters of sediments in the Gulf Basin, and e) local consolidation of nearsurface deposits due to desiccation and compaction. All factors are present in the Balize complex area.

The rate of the true sea level rise component of subsidence has declined during the Holocene period as the effects of the waning of the last continental glaciation have declined (Saucier 1994). Sea level reached its last glacial maximum lowstand about 18,000 years ago and began rising rather rapidly thereafter. About 10,000 years ago, for example, the rate of sea level rise might have been as high as 20 mm/yr (0.79 in/yr), but between 5,000 and 3,500 years ago, it is believed to have declined to 6 mm/yr (0.24 in/yr). Within the last several centuries, it probably has averaged less than 1 mm/yr (0.04 in/yr). However, when other components are included, the total subsidence rate for the deltaic plain over the last several thousand years has been estimated from geological evidence at about 2.38 mm/yr (0.09 in/yr) (Kolb and VanLopik 1958).

There can be no doubt that the highest rates of subsidence currently occur in the Balize complex. Although the rate of sea level rise during historic times has been relatively low in a geological context, basement sinking, faulting, and especially local consolidation of sediments have been quite active. Based on tidal records and observations of structures (Kolb and VanLopik 1958), estimates of late historic-period subsidence at locations such as HOP, Burrwood, Balize, and Port Eads vary from about 5.0 to 48.0 mm/yr (0.19 to 1.9 in/yr) with the mean value being 23.0 mm/yr (0.9 in/yr). Considered in a different perspective, it has been estimated that the shallowest Pleistocene formation underlying the complex, deposited at least 30,000 years ago, has been downwarped by about 152 m (500 ft) by the processes of subsidence.

The effects of subsidence are manifest strongly in the Balize complex in ways other than the sinking (and sometimes burial) of artificial structures. In the cases of the Joseph and Double Bayou crevasse systems which have become largely inactive, there has been a dramatic loss of vegetated wetlands and a corresponding increase in the extent of shallow open water in the last several decades (May and Britsch 1987). In addition, perhaps two-thirds of the wetlands below river mile 12 below HOP, were destroyed by erosion between 1932 and 1983. On the other hand, perhaps aided by the deposition of dredged material, there has been almost a doubling of wetlands in narrow bands along the pass between river miles 0 and 12 below HOP. Much of the wetland loss is attributable to canal dredging by the petroleum industry, but overall wetland loss probably is due to salt water intrusion and plant community changes as well as to the decline in Mississippi River discharge and sediment load caused by the growth of the Atchafalaya River distributary in south-central Louisiana.

Geomorphic Processes And Depositional Environments

Discussion of the sedimentary facies and depositional environments of the West Bay Diversion Project Area are complex due to the fact that elements typical of shallow-water deltas are present along with those unique to the Balize deep-water delta. Initially, brief descriptions will be presented of seven environments--four subaerial and three subaqueous. These are listed under the heading *Balize Delta* since they pertain to both the complex (single lobe) as a whole as well as individual crevasses. Subsequently, discussions will be presented of three geomorphic elements--not environments *per se*--that are unique to the major passes of the Balize delta.

Balize Delta

Subaerial Environments. The natural levee environment includes those small, linear ridges that flank both sides of a channel (e.g., distributary) that carries a heavy suspended sediment load and that periodically overtops its banks. The ridges are composed of firm to stiff, oxidized silts and silty clays. They are highest, thickest, and coarsest adjacent to the channel and thin and decrease in elevation in a distal direction. They become thinner and narrower in a downstream direction and the deposits extend a

few meters into the subsurface because of local and regional subsidence. Soils associated with natural levees have not been delineated in detail, but are described by Garofalo and Burk and Associates, Inc. (1982) as Sharkey-Commerce, frequently flooded association. These are level, poorly drained, and frequently flooded.

The vegetation of interdistributary wetlands already has been described. The deposits consist of several meters of dark gray to black, watery, organic ooze or muck underlain by very soft, gray, organic clays. They occur laterally adjacent to natural levees and extend outward as flat, intratidal tracts, eventually giving way to shallow ponds, lakes, and bays. Drainage is sluggish and by way of narrow, sinuous tidal channels. Soils are described only as Medisaprists, Fresh Association. In the Balize complex, all vegetated wetlands begin as accreting mudflats that are colonized when they become emergent.

Abandoned distributaries are channels whose basic role has changed from carrying river discharge during high stages to accommodating local drainage as tidal channels. In relatively more inland settings, such as near the parent channel, distributaries will shallow and may even become narrower upon abandonment due to sediment filling (mostly loose silts and clays) and eventual plant colonization. In relatively more distal locations where the wetlands are deteriorating, the channels will shallow but actually become wider due to accelerated bank erosion. Upon abandonment, natural levees flanking the distributaries will no longer accrete and keep pace with subsidence, eventually disappearing beneath sea level.

Beaches, and related longshore bars and spits, may form around the flank of an abandoned, subsiding lobe if it is exposed to sufficient wave action and currents. These develop as thin, narrow ribbons of silt with some shells, materials that are winnowed and redistributed from eroding mudflats, vegetated wetlands, and natural levees. These usually are very ephemeral features that often are destroyed in a major storm. In the Balize complex, beaches are present only on the south and east sides of crevasses or lobes that are exposed to prevailing winds.

Subaqueous Environments. The bay-sound environment is a shallow water one dominated by fluvial-marine processes in which mostly silts and silty clays accumulate as a result of the erosion and winnowing of deltaic deposits by waves and currents (Kolb and VanLopik 1958). Bays of the Balize complex are bordered by interdistributary wetlands on the landward side and open out into deeper water environments on the seaward side. The deposits contain a small amount of shell and shell fragments and can be anywhere from a few centimeters to a few meters thick. The thickest and coarsest deposits occur in the deeper and less-protected waters. Bays may either fill or enlarge within a matter of decades depending on cycles of crevasse growth and decay.

The delta front environment occurs in moderate water depths (generally 15 m [50 ft] and more) seaward from bays and sounds. It is characterized by alternating silts, fine sands, and clays that are deposited in Gulf waters ahead of advancing distributaries of lobes or crevasses (Coleman and Gagliano 1964). The deposits are highly lenticular in plan with the nature of deposits dependent upon the pattern and rate of advancing distributaries and the amount of marine action. This environment also includes the bars that form at the mouths of the major distributaries like Southwest Pass.

Still deeper waters flanking the Balize complex are characterized by the prodelta environment. Deposits of this environment consist mostly of soft plastic clays with some silt in the form of thin lenses or lamina. These fine-grained materials accumulate to appreciable thickness in relatively deep water as the first manifestation of an advancing delta and overlie shelf deposits representing an open marine environment. As determined from numerous borings, the deposits are the most homogeneous of all associated with a delta complex or major lobe (Kolb and Kaufman 1967). They attain a thickness of

between 61 and 122 m (200 and 400 ft) beneath Southwest Pass according to Fisk and McFarlan, Jr. (1955).

Delta Chronology

Geologic events older than the last glacial maximum about 18,000 years ago are not directly relevant to the purposes of this report. The chapter in the geologic history of the area that is of initial concern is the beginning of the deltaic plain formation. The first hypothesized delta complex is believed to have begun forming offshore from central Louisiana about 9,000 years ago when sea level was perhaps 16 m (52 ft) lower than at present (see discussion in Saucier 1994). The first complex with preserved deltaic deposits, the Maringouin, dates from about 7,200 years ago when sea level was about 6 m (20 ft) below present. Since that time, the plain has built up and built out by the coalescing of 14 lobes of three additional separate complexes (Frazier 1967). However, during all of that time and multiple sedimentary cycles, the Balize complex area remained as shallow, open Gulf waters.

It is accepted by virtually all workers that the modern delta of the Mississippi River began when the river diverted near New Orleans, LA, into an interdistributary lowland between the La Loutre lobe of the St. Bernard complex to the east and the Bayou des Familles lobe of the same complex to the west (Frazier 1967). The new lobe, called the Plaquemines or Plaquemines-Modern complex, generally is believed to have begun forming about 1,000 to 1,200 years ago (Coleman and Roberts 1991; Frazier 1967; Kolb and VanLopik 1958). Since that time, it has expanded progressively southeastward past the towns of Pointe a la Hache and Buras.

When the Balize or birdfoot delta *per se* began to form south of Venice or the HOP is subject to debate and considerable uncertainty despite its young age. Estimates range from as little as 200 to 250 years (Frazier 1967) to the more generally accepted value of about 500 years (Kolb and Van Lopik 1958; Russell 1936). All estimates are based largely on inference and extrapolations from the historical period rather than discrete evidence.

Part of the uncertainty is due to not knowing exactly when the delta was discovered by European explorers and what its shape and extent were at the time. The most succinct discussion of this topic is that of Russell (1936). He reported that Vespucci may have been the first to see the delta in 1487 or 1498, and Columbus supposedly prepared a map showing the delta in 1507. It is uncertain as to whether multiple major passes existed at the time. Pineda is credited by most with the actual discovery of the delta in 1519, but it may actually have been as late as 1528. At the other extreme, Russell cites one source (Thomas) as saying that Southwest Pass may have only started to form in 1730. This is consistent with estimates by Giardino (1984), based on interpretations of historical narrative accounts, that the mouth of the river was approximately at Venice in the late 17th century and was about 9.6 km (6 mi) farther southeast ca. 1712. These dates seem much too late based on geological considerations and twentieth century data.

CHAPTER III

HISTORY OF PROJECT AREA

Introduction

The project area (Figure 2) is situated just north of the Head of Passes along the west bank of the Mississippi River in Plaquemines Parish. Plaquemines Parish is a peninsula that consists primarily of swamplands and sea marsh; most of the non-swamp or marsh land is located on the banks of the Mississippi River. The west bank of the Mississippi River between The Jump (mile 10.5 AHP) and the Head of Passes, which contains the project area, is unoccupied. A natural levee forms the bank of the river, which is covered by a narrow belt of woods, predominately willow. Behind the willow, brackish marsh is crossed by waterways and pipeline canals. The marshlands extend southwest to Grand Pass, which is formed in part by the eastern edge of the West Bay sub-delta complex deposits. No manmade structures are found in the region except for a 10 inch submarine oil pipeline belonging to the Gulf Refining Co. that crosses the river at Mile 9.8 AHP. Other pipelines cross the Mississippi River at Miles 9.2, 9.0, 7.2, 7.0, 3.9, and 3.3 AHP. South of the project area, the Pass a'Loutre State Waterfowl Management Area is located along part of the west bank of the main channel of the river between Mile 1.5 AHP and the Head of Passes, and along the west bank of Southwest Pass between the Head of Passes and Mile 2.4 BHP (Goodwin et al. 1985:22).

Cubit's Gap is located on the east bank of the Mississippi River, to the east of the project area. It is located between Mile 3.5 and Mile 2.8 AHP. Water flows from the main channel of the river northeast through Cubit's Gap into Main Pass, Octave Pass, and Raphael Pass. The east bank of the river along the project area is partially wooded, primarily with willow. This portion of the river bankline has been formed mainly by recent sediment deposited about the submerged or exposed dikes and wing dams constructed along the river channel. Immediately below Cubit's Gap, between Mile 2.8 and Mile 1.8 AHP, oil storage tanks and the historic community of Pilottown are located (Goodwin et al. 1985:23).

This chapter briefly summarizes the history of the project vicinity, which is intimately tied to the development of the delta as a transportation network. Previous investigations in the vicinity of the project area and recorded shipwrecks in the vicinity also are discussed in this chapter.

Historical Setting

Spanish Coastal Exploration in the Gulf, 1508-1521

The first Europeans to sail in the Gulf were Spaniards, probably Sebastian De Ocampo in 1508 in the southern Gulf (Worchester and Shaeffer 1956), and Ponce De Leon in 1513 in the northern Gulf of Mexico (Lawson 1946).

Further exploration of the Gulf took place from Cuba, which became a jumping off place for Spanish discoveries along the long Gulf Coast. During the early 1500s, Alonso Alvarez de Pineda explored in detail the shores, bays, rivers, and Mississippi Delta of the northern Gulf from Vera Cruz to Apalachee

Bay in Florida. Pineda's observations included some of the first information on winds and currents in the higher latitudes of the Gulf favorable to vessels (Coastal Environments, Inc. 1977).

Spanish Exploration of the Interior, 1528-1561

Two attempts were made before the middle of the sixteenth century to explore the interior of the northern Gulf of Mexico. In 1528, an expedition was led by the Spaniard Panfilio de Navaraez who landed north of Tampa. A second attempt took place in 1539 by Hernando De Soto, governor of Cuba, who explored the Southeast. Other attempts at colonization at various points along the northern Gulf took place from 1549 until 1559; none of these attempts were successful. These territories proved so inhospitable for the Spanish that in 1561, the Spanish king declared that no further efforts at colonizing the northern Gulf would be made. Over a hundred years would pass before a European power again would attempt to settle and colonize the eastern and northern shores of the Gulf (Priestly 1928).

French Explorers and Colonists, 1682-1766

Since Spain had neglected to press her claim over the entire Gulf coast, especially the key to the Gulf, the Mississippi River, this area was open for European possession. In 1682, René Robert Cavalier, Sieur de La Salle, traveled down the Mississippi River to its mouth and took formal possession of it. La Salle noted that the river flowed through three channels into the Gulf of Mexico. After claiming the entire Mississippi Valley for France, La Salle returned by river to Canada (Wilds et al. 1996:2-4).

In 1699, Pierre Lemoyne, Sieur d'Iberville, relocated the mouth of the river for France (McWilliams 1981:137-138). Initially, the French intended to fortify and colonize the mouth of the river, but the inhospitable marshlands and bayous on the Mississippi Delta discouraged them. Instead, the French concentrated their efforts at settlement in the vicinity of Mobile, rather than along the lower reaches of the Mississippi (Wilds et al. 1996:8-11).

During the colonial period the Southeast Pass was preferred as the principal point of entry into Louisiana and passage to New Orleans, which was founded in 1718. In an attempt to guard the mouth of the pass, the Chief Engineer of the French colony of Louisiana, Pierre Blond de la Tour, established a fort on a small island; the fort also functioned as a lighthouse. The installation was known as the "Balise," meaning "beacon" or "buoy" in French (Lincoln 1983).

The Mississippi River grows sluggish at the passes, decreases in velocity, and deposits an immense amount of sediment at the river's mouth, thus "creating a shoal which reduces the depth of navigable water at the most crucial point of the whole river system" (Clay 1983:22). The marshes and bayous to the west of the study area were created through countless years of sediment buildup as the Mississippi River pushed its discharge into the Gulf.

The French never solved the problem of maintaining a deep channel through the passes. The average depth of the passes was approximately six to eight feet. That provided sufficient depth only for small vessels to cross the bar at the mouths of the passes. In 1726, the French initiated a process known as harrowing, by which ships would drag iron harrows along the bottom of the outlets in order to break up sand bars. The deeper channels thus achieved were only temporary since the sand bars and shoals quickly re-formed (Clay 1983:22).

In the meantime, the fortifications at Balise slowly sank into the mud. By the 1760s, the French had reduced the stronghold to a small battery of cannons (Lincoln 1983:338). Nevertheless, Balise served as the

site where France officially transferred the colony of Louisiana to Spain in 1766 at the conclusion of the Seven Years' War (known in America as the French and Indian War).

The Passes Under the Rule of Spain, 1766-1803

Like the French, the Spanish continued to use the Southeast Pass as the chief gateway to the colony of Louisiana. Spain granted to a chief pilot who resided at Balise, the exclusive privilege of controlling the entry and exit of ships that attempted to trade with New Orleans and points along the river. Under the Spanish, the passes remained as perilous to navigate as they had been under the French (Goodwin et al. 1985:47-50).

The Euro-American occupation of Plaquemines Parish was accomplished early in the eighteenth century; the first settlement was made at Pointe-al-a-Hache. It was during the Spanish Period of control of Plaquemines Parish that the groundwork was lain for its future industries. Sugar became the major crop north from about Pointe a la Hache. To the south, rice became the major agricultural product. The southern region also saw the first orchards being developed, although at first no single fruit type predominated. Myrtle, indigo and a timber trade came into production in the area. By the 1790s, sugar mills began to dot the riverbanks because of the development of sugar crystallization by de Bore. In addition, the seasonal products of this region were supplemented by hunting and fishing (Stringfield 2000).

The Passes Under American Rule, 1803-1852

Spain ceded Louisiana to France in a secret treaty of 1800, but the Spanish maintained the governmental institutions for the colony until 1803, when the territory was purchased from France by the United States. Under American rule, trade on the Mississippi River increased rapidly, particularly after the development of the steamboat, which could move upstream against a strong current.

The advent of the steamboat transformed New Orleans into a major American port; this magnified the need to solve the problem of the shallow passes and outlets to the Gulf. Southeast Pass, the preferred gateway to the river during the colonial period, was replaced by the Northeast Pass early in the nineteenth century. All of the passes presented similar problems to navigation, and harrowing continued to be used to break up the sand and shoals at the mouth of the river. In 1835, Congress appropriated $250,000 to conduct dredging projects at all the passes. Almost all of the appropriated money was spent on surveys and on the construction of a dredging vessel called the *Belize.* The *Belize* experienced numerous mechanical difficulties and never functioned properly.

A lively debate ensued in the 1840s over methods for dealing with the problem of the deltaic shoals and sandbars at the passes (Clay 1983:23). While the debate was proceeding, the Northeast Pass (then the favored route) filled with shoals. Consequently, the Southwest Pass assumed a new importance, as did a community on the pass known as Pilot Town, where ship pilots were headquartered (Gould 1889:314).

After the Battle of New Orleans, the small sugar mills of the earlier period of the history of the Parish grew into plantations and eventually into self-sufficient villages. By 1830, there were about twenty such villages in existence on both banks of the Mississippi River, down to about Myrtle Grove on the West bank, and to Phoenix on the East bank. Smaller plantations and a few small farms, also were scattered throughout the area. The Pointe a la Hache area southwards was dominated by rice farming.

Navigation of the Passes, 1852-1898

Navigation problems along the passes continued. For example, in 1852 alone, more than 40 vessels were grounded in the shallows and on mud lumps just outside Southwest Pass for periods ranging from two days to eight weeks. To detach themselves, vessels sometimes would attempt to lighten their loads by throwing cargo overboard (Gould 1889:315). Only small vessel types could attempt to enter Southwest Pass through Scotts Canal and Double Bayou on their way north through the study area above the Head of Passes.

Before the Civil War, fishing became a major source of income for the people of Plaquimines Parish as markets for the product opened in New Orleans. Seafood was harvested in larger quantities. Local methods for seafood preservation developed by the first settlers--such as salting and drying--meant that fish and shrimp could be transported without spoilage. Fresh oysters also were transported to New Orleans in the cooler months. In 1854, a packet sailed twice per week through the project area between New Orleans and Balize. It transported local products, including exotic plants and fruits such as oranges, peaches, pears, figs, and plums, from Plaquemines Parish back to New Orleans (Stringfield 2000).

During the Civil War, a major military objective of the Union was the control of the entire course of the river including the passes. At the beginning of the war, the Federal forces set up a naval blockade of the Confederacy at the mouth of the river, while the Confederates placed obstructions in the channel to defend the entrance to the river and access to New Orleans. A vessel in the blockading fleet, the U.S.S. *Richmond*, struck a submerged wreck on the inner bar of Southwest Pass in late September, 1861 (Stewart 1903:690). A few days later, the U.S.S. *Vincennes* collided with a sunken vessel that blocked the channel (Stewart 1903:696). However, more than a century of erosion and dredging seem to have eliminated these obstacles; present day shipwreck databases record no such obstructions from the Civil War era.

In October 1861, a Federal force attempted to establish a battery at the Head of Passes to the south of the study area, but Confederate vessels succeeded in driving the Federals from the river. During the endeavor, several Federal vessels became stuck on the bars at the passes. Nevertheless, the Union fleet gained control of the mouth of the Mississippi (Bragg 1977:268-269).

Efforts to deepen the channels at the Head of Passes resumed after the Civil War ended. Dredging by the Corps of Engineers proved difficult and expensive (Clay 1983:23). In the 1870s, James B. Eads, proposed a solution whereby jetties were to be erected at the mouth of the Southwest Pass in order to maintain and deepen the channels (Pearson et al. 1989:184-185). The Federal government provided Eads with funds, but only for a trial project of jetty building at South Pass. The resulting improvements at South Pass proved Eads' theories, which consequently led to a 2,600 per cent increase in exports from New Orleans (Dorsey 1947:216). Within five years of the jetties' completion, New Orleans moved up from eleventh to second place among American ports (Morgan 1971:167).

In 1890, the staple products of Plaquemines Parish were sugar, rice, oranges, corn and farm and garden vegetables. The size and quality of the oysters found in the numerous bayous, bays, and indentations of Plaquemines coast also became an important commodity (*Biographical and Historical Memoirs of Louisiana*, 1892).

Oystering became a common practice in Plaquemines after the arrival of the Dalmatians. Originally, the oysters were clustered in a couple of reef areas, one in Quarantine Bay-Black Bay and at Battledor Reef. In time, bays close to settlements were developed into oyster farms. These farms served New Orleans markets during the winter months. As the quantity of oysters increased, oyster factories opened to steam and can them. Steaming and canning plants were located in Olga, Ostrica, and Myrtle Grove. Later the introduction of railroads and refrigerated cars meant that fresh oysters could be shipped to markets in New Orleans and beyond. Other seafood, such as shrimp, also was harvested to bring in

money. Local fishermen developed luggers, boats rigged for doing both jobs of shrimping and oystering. Shrimping and oyster fleets are based on bayous and canals that connect the river with coastal bays and sounds west of the West Bay Diversion Area (Stringfield 2000).

An important early occupation throughout Plaquemines Parish was the harvesting of wild animals for their furs. Muskrats were very abundant, netting about 1,000 furs per trapper per season. Other furs taken from the marshlands were raccoons, otter, mink, and beaver. Hunted birds included geese and ducks, which came to the marshes of the lower Plaquemines. Eventually, a tourist industry developed along the bayous and marshlands of Plaquemines as hunters from outside were attracted to the region. They hired local guides, built private lodges, and took back salted goose and duck meat along with oysters and oranges (Stringfield 2000).

The Project Area from 1898-present

Continued Efforts to Improve Navigation in the Passes. In 1898, Congress authorized funds to conduct a survey on the feasibility of creating a 35 ft channel through Southwest Pass. Affirmative recommendations finally resulted in the channel being completed in 1911. The channel was maintained regularly from 1920. Support facilities, which included residences, and administrative and industrial buildings, were also established at the Burrwood Reservation (Chief of Engineers 1899:1863, 1914:2566; Goodwin et al. 1985:122).

In the summer of 1941, on the eve of American entry into the Second World War, construction began on a Navy Section Base in the lower portion of the Burrwood Reservation just below the study area. The military installation was intended to engage in anti-submarine warfare. From the time that the war actually began until 1943, German submarines posed a significant threat to commercial shipping from the Mississippi River. A German submarine sank the oil tanker *Virginia* close to the Southwest Pass early in 1942 (Morison 1961:140-141). On the same day, the Germans fired at a destroyer but missed their target; instead, the torpedo hit the jetties near the lighthouse on Southwest Pass (Goodwin et al. 1985:115).

In 1945, the United States Congress combined several navigational projects into the "Mississippi River, Baton Rouge to the Gulf of Mexico" project, which included the Southwest and South passes. This legislation enlarged the Southwest Pass to 40 by 800 ft and the Southwest Pass Bar Channel to 40 by 600 ft In 1962, additional legislation was passed to deepen the channel between Baton Rouge and New Orleans to 40 ft (Secretary of the Army 1996:11-13). By 1963, the 40 ft channel was completed for a distance of 30 mi, from just below the town of Venice through the study area to the Gulf of Mexico. From 1964 to 1980, annual maintenance dredging for this 30 mi stretch produced an average 20 million cubic yards of spoil per year. Unfortunately, subsidence and erosion within this reach led to loss of riverbanks and to river widening in several areas. While this loss of river water benefited the surrounding marshes, it caused increased shoaling within the navigational channel (Carney 1984:EIS44).

Plaquemines Parish in the Twentieth Century. After sulfur and oil were discovered in the 1930s and 1940s, the area began to grow rapidly. During the period 1930-50, Plaquemines Parish developed three major oil field areas about two to five miles from Venice as well as two sulfur mines. The two sulfur mines are at Grand Ecaille, ten miles from Port Sulphur, and at Garden Island Bay near the mouth of the Mississippi River. Grand Ecaille has been in operation since 1933 and is the world's second largest Frash-type producer. Garden Island went into production in 1953. Louisiana began to develop its offshore oil and gas fields during the late 1940s. They have been extended by discoveries in areas adjoining the Mississippi River below New Orleans in the Gulf. The development of the pipeline industry has led to the construction of numerous oil production facilities and submarine pipelines throughout the region including the project area (Meyer 1981:84).

Major oil companies (for example, Gulf Refining Company, Gulf Oil Corporation, Southern National Gas Company, United Gas Pipeline, Cal-Ky, and Tenneco) operate facilities throughout the region and operate close to 1,000 miles of oil pipeline in Plaquemines Parish. Supporting oil storage facilities are found at Ostrica Terminal, Grand Bay Station, West Bay Station, and at Empire Terminal. There also are about 200 mi of gas transmission and distribution lines for domestic use in Plaquemines Parish. They are found mainly to the north of the project area serving industrial, commercial and residential customers on the west bank of the river from Myrtle Grove to Venice (Meyer 1981:86).

Muller's (1985) underwater survey of Venice to the Gulf, mentions that a large number of pipelines exist in the river below Venice. The survey recorded twenty-one pipelines on charts and two additional abandoned lines. The largest was a 36 inch Tennessee Gas Co. line at mile 11.75 BHP. To the east of the project area, at Cubit's Gap, pipelines crossed from the west bank into the Gap with a heavy silt accumulation in the mouth of the Gap. Previously related pipeline activities appeared as magnetic anomalies during Muller's survey. They were found to be directly across from Cubit's Gap in the present project area where an oilrig had been placed within 50 m of the edge of the river. A cluster of magnetic anomalies was recorded right in front of the same location. Conversations with company oil workers identified the anomalies as being the remains of a crate of pipefittings and related smaller materials inadvertently dumped in the river (Muller 1985:12-13,18).

Throughout the years, this region of the river has been greatly affected by man through the shaping of the banks and maintenance of the river channel. The activities have led to the creation of numerous man-made obstructions that include vessel wrecks, submerged pipes, cable areas, spoil areas (dredged materials), and dump sites (District Engineering Officer 1916). See Table 1 for listings of obstruction types.

Today fully developed industries of Plaquemines Parish are multi-faceted and no longer depend mainly on the original sources of agriculture, animal harvesting, and mineral extraction. According to the US Government Census, of the 13,120 workers in Plaquemines Parish, the segment that employed the largest number of personnel in Plaquemines Parish in 1997 was the service economy (2,778). It was followed by the manufacturing industry (2,483), transportation and public utilities (2,253), retail (1,550), construction (1,493), wholesale trade (1,180), mining (986), and agricultural services, forestry, and fishing (20-99). Agriculture, forestry, fishing, and mining are now at the bottom of the list of employers although the profits from those sectors may be high, especially in the highly mechanized area of mining that includes oil and mineral extraction. In the area of transportation, water transportation employed the largest number of personnel dealing with freight, cargoes, passengers, cargo handling, and towing and tugboats (Bureau of the Census: 1997 County Business Patterns for Plaquemines Parish).

Table 1. Possible Bottom Obstruction Types from Industrial, Commercial, and Other Sources

(source: Coastal Environments, Inc., 1977)

OBSTR. TYPE	MATERIALS	OBSTR. TYPE	MATERIALS
Industrial		**Commercial Mariners**	
cables	metallic core	anchors	metal
chains	metallic core	chains	metal
drilling bits	metallic core	equipment	metal
drums	metal	fishing tackle	metal, plastic
lost/broken tools	metal	nets	fiber, plastic
oil wells	metal	various junk	various
pipe stems	metal		
pipelines	metal		
spoil areas	channel dredging		

CHAPTER IV

PREVIOUS INVESTIGATIONS

Previous Cultural Resources Surveys

A total of nine previously completed cultural resources investigations were identified within 8 km (5 mi) of the currently proposed West Bay Diversion project area. Each of these investigations is discussed in chronological order below.

In 1978, Coastal Environments, Inc. conducted a cultural resources survey of Grand and Tiger Passes and Baptiste Collette Bayou in Plaquemines Parish, Louisiana (Gagliano et al. 1978). This investigation was completed on behalf of the U.S. Army Corps of Engineers, New Orleans District. The proposed project area consisted of bankline surveys of Tiger and Grand Passes and Baptiste Collette Bayou. The investigation was designed to identify and evaluate cultural resources impacted by channel improvements, including dredging and related spoil disposal. Fieldwork consisted of a reconnaissance survey of both waterways. The investigation failed to locate any significant cultural resources within the survey area. No additional testing of the project area was recommended.

In 1979, Heartfield, Price, & Greene, Inc. completed a cultural resources survey of the Delta-Breton National Wildlife Refuge in Plaquemines and St. Bernard Parishes, Louisiana (Jackson 1979). The investigation was conducted on behalf of the Heritage Conservation and Recreation Service, Office of Archeology and Historic Preservation in consultation with the United States Fish and Wildlife Service. The Area of Potential Effect was limited to two project areas, the headquarters development complex and the Venice Boat Docking Area. Field methods used for this survey consisted of informant interview, pedestrian survey, and shovel testing. As a result of the survey, two previously identified prehistoric sites, 16SB23 and 16SB25, and three historic sites (no site numbers given) were located. Both prehistoric sites were described as shell deposits associated with the occupation of the St. Bernard sub delta and the Marksville period respectively. The historic sites consisted of two collections of wood frame building remains and one possible cemetery. With regard to the historic sites, no further testing was recommended. However, further testing was recommended for the two prehistoric sites. The National Register status for both the prehistoric and the historic period sites was not assessed.

During 1979, Tulane University conducted a cultural resources survey of the East Bank Barrier Levee in Plaquemines Parish, Louisiana (Davis et al. 1979). This survey was completed on behalf of the U.S. Army Corps of Engineers, New Orleans District. The project was designed to locate and evaluate any prehistoric and historic period cultural resources located along those portions of the Mississippi River included within the East Bank Barrier Levee Plan of the New Orleans to Venice Hurricane Protection Levee System. Field methods for this survey included pedestrian survey, limited trowel testing, and unit excavation. This investigation resulted in the identification of 23 archeological sites, four of which had been previously recorded, including Fort St. Phillip (16PL39), 16PL61 (Olga), 16PL66 (Ostrica), and 16PL69 (Tabony Cemetery). A total of twenty sites was assessed as ineligible for nomination to the National Register of Historic Places: 16PL64, 16PL65, 16PL67-80, Y16PLA, Y16PLB, Y16PLD, and

Nestor Canal II. Sites 16PL66 and 16PL82 were assessed as potentially significant and further testing was recommended. Fort St. Phillip already was listed on the National Register.

In 1982, the Texas A&M Research Foundation and the Texas Engineering Experiment Station, Environmental Engineering Division conducted a methodological evaluation of underwater instrumental search in the lower Mississippi River from Venice, Louisiana to the Gulf of Mexico (Garrison and Baker 1982). This evaluation was completed on behalf of the U.S. Army Corps of Engineers, New Orleans District. Six survey areas were covered by the survey. These included the Boothville Survey Area, located in the vicinity of River Mile 16 roughly opposite the Boothville-Venice Public High School; the Wildlife Refuge Survey Area, opposite Delta National Wildlife Refuge at River Mile 4-5; the Southwest Pass Survey Area, located in the major portion of River Mile 5, below Head of Passes; the *CSS Manassas* Site, a localized sub-area of the Boothville survey area, the *CSS Louisiana* Site, located by Fort St. Phillip on the left descending bank; and the Fort Jackson to Bolivar Point Area. Field methods used for this survey included side-scan sonar, sub-bottom profiler, proton magnetometer, and a trisponder survey. An unknown number of wrecks were identified by the survey and their National Register status is unclear.

During 1982, David Stuart and Jerome Green of the National Park Service completed an archeological survey of the Proposed Venice Revetment in Plaquemines Parish, Louisiana (Stuart and Green 1983). This investigation was conducted on behalf of the U.S. Army Corps of Engineers, New Orleans District. Field methods utilized during the survey included windshield survey and pedestrian survey. No cultural materials were identified as a result of the survey and no further testing was recommended.

In 1983, John W. Muller conducted a cultural resources survey of the underwater portions of the Baton Rouge to the Gulf, Deep Draft Access Project (Muller 1985). This investigation was conducted along a 48.3 km (30 mi) portion of the Mississippi River below the Head of Passes, as part of the Deep Draft channel deepening project and Supplement II of the Mississippi River, Baton Rouge to the Gulf Environmental Impact Statement. Fieldwork consisted of a remote sensing survey using a combination of magnetometer, side scan sonar, and a digital sounder. A total of 144 anomalies were identified during the survey. After eliminating pipelines, cable crossings, etc., 33 anomalies were considered to warrant further cultural resource investigation. Of those 33 anomalies, none were found to be within the project areas. None of these anomalies were evaluated during this survey, since this would involve non-electronic examination (i.e., diver verification). Consequently, the National Register status of these anomalies was not assessed although further identification was recommended.

In 1985, R. Christopher Goodwin and Associates, Inc. conducted a cultural resources survey to evaluate the National Register eligibility of Burrwood, in Plaquemines Parish, Louisiana (Goodwin et al. 1985). The project area was limited to the survey of Burrwood, an abandoned U.S. Army Corps of Engineers facility located on the left descending bank of Southwest Pass. Field methods consisted of informant interviews, photographic recordation, topographic survey, surface collection, subsurface testing, and unit excavation. As a result of the investigation, Burrwood was assessed as not significant applying the National Register of Historic Places criteria for evaluation. No additional recordation of Burrwood was recommended.

During 1988, archeologists associated with the Agency for Conservation Archaeology conducted a cultural resources survey to develop a Southeast Louisiana Cultural Resource Management Plan (CRMP) (Chase et al. 1988). This survey was conducted at the request of the U.S. Army Corps of Engineers, New Orleans District. The survey was to result in a broad plan of action that should guide management decisions regarding terrestrial cultural resources affected by Army Corps of Engineers projects within Plaquemines Parish, Louisiana. The Management Area consists of Plaquemines Parish and portions of St. Bernard, Jefferson, Lafourche, and Terrebonne Parishes, including approximately

4634.8 km (2880 mi). As a result, a CRMP was prepared and implemented for the Army Corps. This plan remains in use currently and is systematically updated.

In 1988, the Agency for Conservation Archaeology conducted a cultural resources study for the New Orleans to Venice Hurricane Protection Project (Montgomery et al. 1988). The study was conducted at the request of the U.S. Army Corps of Engineers, New Orleans District. The investigation used information provided in 31 previous cultural resources investigations conducted between 1973 and 1988. A total of 80 sites was recorded within the proposed project area. Of these 80 sites, 40 sites were determined to be either directly or indirectly impacted by the New Orleans to Venice Hurricane Protection Project. Of these 40 sites, three (16PL38, 16PL66, and 16PL27) were currently listed as National Historic Landmarks. In addition, four sites (16PL61, 16PL66, 16PL80, and 16PL82) were assessed as eligible for inclusion on the National Register of Historic Places. It was recommended that further investigation be conducted for those sites considered eligible for the National Register, as well as for site 16PL38.

Previously Recorded Archeological Sites within 1.6 km (1 mi) of the Project Area

The Pilottown Site (16PL98), is an historic, nineteenth century site, located in Section 29, Township 22 South, Range 19 East (Clemensen 1983). The site is situated on the left descending bank of the Mississippi River 1.2 km (0.75 mi) south of Cubits Gap in Plaquemines County, Louisiana. Neither site size nor artifacts recovered is listed. Field methods utilized informant interviews. The site was assessed as potentially significant applying the National Register for Historic Places criteria, and further testing was recommended.

The Old Quarantine Station Site (16PL99) is a nineteenth century site, located on the left descending Mississippi River bank approximately 1 km (0.6 mi) north of Cubits Gap, within the Delta-Breton National Wildlife Refuge in Plaquemines County, Louisiana (Clemensen 1983). The site is located in Sections 17 and 18, Township 21 South, Range 19 East and is approximately 61 m (200 ft) by 305 m (1000 ft). There was no description of artifacts recovered. However, the cultural affiliation of Site 16PL99 is listed as 1820s to 1870s. Although the field methods employed are unknown, the site was assessed as potentially significant applying the National Register for Historic Places criteria, and further testing was recommended.

Shipwrecks in the Vicinity of the Project Area

Two sets of tables of shipwrecks are presented here as examples of ship types plying the waters of the Mississippi River, although they are incomplete lists of ship types associated with navigation through the project area.

The dangerous situation for navigation through the alluvial tidal bars, mud lumps, shoals, and general shallow condition of channels through the Mississippi River is underscored by the list of shipwrecks in Table 2. They are examples of the great number of maritime accidents that can occur during a short period, in this case from 1892 to 1898, while maneuvering through the shallows of Southwest Pass towards the area of the West Bay Diversion project.

Table 1, a list of possible obstructions, industrial commercial and private, that may be encountered in the survey area, was prepared after a thorough review of available documentation at several diverse repositories. The examined resources included the Automated Wreck and Obstruction Information System

Table 2. Shipwrecks in the Vicinity of Southwest Pass

(sources: **ATN**: *Aids to Navigation*, United States Coast Guard; **AWOIS**: *Automated Wreck & Obstruction Information System*, 1999. **B**: Berman, Bruce D., *Encyclopedia of American Shipwrecks*, 1972; **HO**: Hydrographic Office, U.S. Navy, *Hydrographic Office Wreck Information List*, 1945; **LH**: C. Bradford Mitchell, "The Lytle-Holdcamper List," 1975; **NM**: *Notices to Mariners*, Hydrographic Office. **NIMA**: National Image and Mapping Agency, U.S. Navy, 1999; **W**: Way, Jr., Frederick, *Way's Packet Directory, 1848-1994*.) **1007-A**: Hydrographic Office, U.S. Navy WWII vessel wreck chart no. 1007-A, 1942)

Vessel/ Obstruction Name	Record No.	Vessel/ Obstruction Type	Year Built	Place Built	Tons	Dimensions	Date Lost or Reported	Cause	Location	Disposition	Notes: Sources
BB 5		barge	1932		964		12/17/63	foundered	at mile 24.9 AHP		at Cable Crossing, Buras, LA [B]
Blue Water I		barge	1957		641		10/6/64	storm	in W Delta Block 104		[B]
Bonus Kin	AWOIS: 8371	fishing vessel				73 ft long	0/0/1967	sunk	at left descending side of SW Pass inside dike mile 19.7 BHP	possibly removed in 1967	[AWOIS]
Buccaneer		oil screw	1954		64		11/8/65	foundered	approx. 20 mi W of SW Pass		[B]
Captain R.J. Sanders	AWOIS: 8372	fishing vessel		Lafitte, LA		41.1 ft long, 14.1 ft wide, 4.1 ft deep	0/0/1967	capsized	**28-53.5-00N, 89-23.6-00W** (pos. approx.)	sunk	sunk in 9 fathoms [NM] (1967); in 1971 area cleared to 68 ft, but wreck not located
Compadre		oil screw	1929		85		7/20/53	burned	halfway between head and mouth of passes		[B]
Espisisa	AWOIS: 8367	fishing vessel					0/0/1973		**28-55-00N, 89-25-00W** (pos. approx.)	missing from reported location	sunk 200 yds in outside channel at mi 19.2 BHP [AWOIS]
G.R. Co. 4		Barge;steel	1937		117		2/21/12	Foundered	At Buras, LA		[B]
Governor Morton		clipper	1851		1,430	length: 196 ft	7/2/1877	burned	at mouth of Miss. River		carried cotton cargo [B]
Grampus		steam side wheel	1827	Cincinnati, OH	297		5/13/1840	exploded	at mouth of Miss. River		2 lives lost [B], [LH]
Halo		steam screw tanker; steel	1920		4,301 [1007-A]; 6986 [B]		5/20/42	sunk by submarine	**28-47-00N, 89-49-00W**; also reported at: **28-42-00N, 90-21-00W**, and **28-42-00N, 90-08-00W**; 21 mi SW of SW Pass		39 lives lost [1007-A], [B]
Harry of the West		clipper	1855		1,050		11/1865	burned	near mouth of Miss. River		[B]

Vessel/ Obstruction Name	Record No.	Vessel/ Obstruction Type	Year Built	Place Built	Tons	Dimensions	Date Lost or Reported	Cause	Location	Disposition	Notes: Sources
Jackie D.	ATN: 009-60	motor vessel					1960	sunk	**29-12-00N, 89-16-20W;** in 75 ft. water		[ATN]
John Kurt	AWOIS: 8364								**28-54-48N, 89-22-24W**		[AWOIS]
Kiva		gas screw	1917		69		10/1/39	burned	off entrance of SW Pass		[B]
La Cache	ATN: 084-92	unknown				length: 65 ft.	1992	sunk	**29-11-29N, 89-16-30W;** in 21 ft. water		[ATN]
Louisiana	AWOIS: 309	gunboat (wood hull) (Confederate)	1861-62	New Orleans		length: 264 ft.	April 1862	blown up by Confeds.	**28-59-12N, 89-08-06W;** moored by Fort St. Philip		[AWOIS]; similar to Eads gunboat (sloping side casemate); served as floating battery [W]
Malcolm B. Toomer		oil screw	1954		78		11/11/66	foundered	SW of SW Pass		[B]
Maverick		Barge	1964		2,995			Hurricane	In Miss. River Delta		[B]
Mingo		schooner; steel	1904		397		3/19/20	collided with unknown steamer	at SW Pass		2 lives lost [B]
Miss Pat	AWOIS: 8365								**28-55-12N, 89-22-18W**		[AWOIS]
Nola		gas screw; steel	1919		595 net		11/9/22	burned	**28-55-00N, 89-40-00W;** SW of SW Pass		longitude erroneously listed as 89-04-00 [1007-A], [B]
R.O. 2	NIMA: 32112	barge					2/20/65	marine casualty	**28-54-00N, 89-27-00W**		[NIMA]
R.O. 2	NIMA: 32615	barge					7/1/67		**28-53-58N, 89-27-06W**		[NIMA]
R.O. 2	NIMA: 32767	barge					4/20/68		**28-54-01N, 89-27-09W**		[NIMA]
Tiger		steam side wheel	1837	Wheeling, VA	364		11/13/1844	exploded	at SW Pass		3 lives lost [B]
Victoria		oil screw	1923		117		11/1/27	burned	at Buras, LA		[B]
Virginia	AWOIS: 290 NIMA: 36000	steam screw tanker; steel	1941		8,472 [HO]; 10,731 [B]		5/12/42	sunk by submarine	reported at approx. pos.: **28-53-06N, 89-26-42W,** and: **28-53-00N, 89-29-00W**	reported silted over, 12/20/43	27 lives lost; lay 150 yds from red SW Pass Wreck Lighted Buoy No. 2, and discontinued 12/20/43 cleared w/o hang to 54 ft; located in 1950: [1007-A], [HO], [B], [NM]
Yuma		steam screw					3/17/26	unknown	**28-56-35N, 89-26-37W**		[HO], [B]

Vessel/ Obstruction Name	Record No.	Vessel/ Obstruction Type	Year Built	Place Built	Tons	Dimensions	Date Lost or Reported	Cause	Location	Disposition	Notes: Sources
unknown	AWOIS: 296 NIMA: 36473	barge						sunk by marine casualty	**28-54-40.85N, 89-25-36.17W** (pos. approx. to 1 mi)		[NM], [AWOIS]
unknown		vessel							**29-12-40.6N, 89-17-20.29W**		[NOAA chart no. 11361 (1999)]
unknown		vessel							**29-11-51.92N, 89-16-51.61W**		[NOAA chart no. 11361 (1999)]
unknown		vessel							**29-11-32.67N, 89-16-30.40W**		[NOAA chart no. 11361 (1999)]
unknown	AWOIS: 351	unknown							**29-13-24N, 88-58-34W**		[AWOIS]
unknown	AWOIS: 355	unknown							**29-14-29N, 89-33-57W**		[AWOIS]
obstruction	AWOIS: 8374	buoy sinkers, chain				two 20,000 lb sinkers; 65 ft chain	00/00/1986	discontinu-ance of lighted buoy	**28-54-17.5N, 89-25-46W** (pos. approx.)	abandoned	[AWOIS]
obstruction	AWOIS: 8373	submerged piling					6/7/05		reported 1 ft above water in 1993 **28-54-30N, 89-26-24W** (pos. approx.)		[AWOIS]
obstruction	AWOIS: 295 NIMA: 36682	unknown							**28-54-24.86N, 89-27-06.17W** (pos. approx. to 1 mi)		reported . Hydrographic Office files dated 7/16/43 [AWOIS]
obstruction	AWOIS: 8369	unknown							reported in 1971 in 26 ft at: **28-54-04N, 89-25-41W**; in 1976 at: **28-54-04N, 89-25-42W**; in 1993 at 50 m from AWOIS position; 750 yds N of #8370		[AWOIS]
obstruction	AWOIS: 8370	unknown							reported in 1993 at: **28-53-48N, 89-25-42W**		[AWOIS]
obstruction	NIMA: 33011	unknown							**28-52-42N, 89-24-48W**		[NIMA]
obstruction	AWOIS: 8444	unknown							**28-49-17.4N, 89-27-42.6W**		[AWOIS]
obstruction	AWOIS: 8368	unknown							**28-49-35.99N, 89-24-49.72W**		[AWOIS]
obstruction	AWOIS: 8366	unknown							**28-54-35N, 89-22-04W**		[AWOIS]
obstruction	AWOIS:3 10	unknown							**28-59-40N, 89-11-45W**		[AWOIS]

(AWOIS) of the National Oceanographic and Atmospheric Administration (NOAA), the National Image and Mapping Agency (NIMA) by the U.S. Navy, and the Coast Guard's *Aids to Navigation* (U.S. Coast Guard 2000).

The research indicated that approximately 30 vessels had been reported as lost near or within the area of the West Bay Diversion Area and down through Southwest Pass. Six obstructions, only three of which were identified, also were recorded. Of the 30 vessels, eight were barges. Most appear to have foundered or were lost during storms of the 1960s, except for one that went down in 1912. The earliest ship types wrecked in the vicinity were two steam side-wheel vessels. Both exploded: the *Grampus* at the mouth of the river in 1840, and the *Tiger* at Southwest Pass in 1844. Two clipper ships were reported to have gone down at the mouth of the Mississippi River, the *Harry of the West* in 1865, and the *Governor Morton* in 1877. Three fishing vessels were lost, two (the *Bonus Kin* and the *Captain R.J. Sanders*) in 1967 and one (the *Espisisa*) in 1973. Screw type vessels are recorded wrecked in the Pass from 1922 to 1966: two gas screw vessels (the *Nola* in 1922, and the *Kiva* in 1939) went down in the Gulf side of the pass; four oil screw vessels (the *Victoria* in 1927, the *Compadre* in 1953, the *Buccaneer* in 1965, and the *Malcolm B. Toomer* in 1966) were lost on both side of the pass; and three steam screw ships were lost, the *Yuma* in 1926, and two steam screw tankers (the *Virginia* and the *Halo*) were sunk by German submarines in 1942 (Table 3).

Close to the mouth of Southwest Pass, three sites have been recorded by the U.S. Navy for the National Image and Mapping Agency. They are items No. 32,767, No. 32,112, and No. 32,615 (see Figure 3 for a map of AWOIS and National Image and Mapping Agency recorded wreck sites). Site Nos. 32,112 and 32,767 are barges reported lost near an oil platform in 1965 and 1968 respectively. Another barge, site No. 32,615, also was lost in 1967 to the south of Nos. 32,112 and 32,767.

The most important vessel wreck in the vicinity is that of the *Virginia*. Listed as AWOIS No. 290 and by the Navy as No. 36,000, the *Virginia*, located immediately south of the mouth of Southwest Pass (Figure 3), was a steel steam screw tanker that was sunk on May 12, 1942, by a German submarine. Twenty-seven lives were lost. It lays 150 yards from the red Southwest Pass Wreck Lighted Buoy No. 2, which was discontinued in 1943 when the wreck was cleared to 54 ft According to AWOIS records, the *Virginia* now is completely silted over (Hydrographic Office 1945; Berman 1972).

Historical nautical charts (NOAA) were researched back to the 1970s for evidence of wrecks and obstructions that might affect the project area. Geologic survey maps (USGS) were researched back to the 1920s for depictions of cultural features along the shoreline parallel to the project area, as well as for shipwrecks. The results of the research noted that three wrecks currently are depicted within and alongside the project area on 1999 NOAA nautical Chart No. 11361 (Wrecks No. 1, 2, and 3 are featured in Figure 4). Wreck No. 1 (29E 12' 40.6", 89E 17' 20.29") appears on NOAA nautical charts for the first time in 1973. The chart locates it in the barge access area and dispersion cut-through proposed by the Corps of Engineers for the west bank of the project area. The Coast Guard's *Aids to Navigation* locates the motor vessel *Jackie D.* (29E 12' 00", 89E 16' 20") close to the NOAA location. It sank in 1960 in 75 feet of water opposite the Quarantine Station on the eastern bank.

Wreck No. 2 (29E 11' 51.92", 89E 16' 51.61") and wreck No. 3 (29E 11' 32.67", 89E 16' 30.4") appear on NOAA nautical charts for the first time in 1992. Investigations into wreck No. 2 show that a wreck was located in approximately the same area in the 1860s and 1870s. Three hydrographic maps, one from 1868 and two from 1875, show a wreck in the approximate position of modern wrecks No. 2 and 3. Gerdes's 1866 map *Hydrography of Part of the Mississippi River, Louisiana* was copied twice in 1875 by the Office of the Chief of Engineers (See Figures 5 and 6). In both copies, a wreck is depicted on the western shoreline as indicated by Gerdes. Boyd's 1868 map *Mississippi River from Cubit's Crevasse to the Forts and Shore of Bird island Sound, Louisiana* (Figure 7) also shows a wreck in approximately the same location as in Gerdes's 1866 map and includes the notation "working beam of wreck". Research at the National Archives

Table 3. Examples of Vessels Grounded or Lost in the Vicinity of the Mouth of Southwest Pass 1892 to 1898

(Source: *US Congress Document No. 142*, 1899)

Date of Incident	Vessel Name	Vessel Type	Disposition	Location
1892	*Charles Luling*	bark	filled with water; lost	900 ft beyond W jetty
1892	*Barbarian*	steamship	grounded 2 days	at channel entrance
1892	*Traveler*	steamship	grounded thrice; pulled off by tugs	at head & entrance of pass
1892	*Akalba*	steamship	grounded for 36 hrs	900 ft beyond entrance
1892	*Dunkeld*	steamship	grounded on lump for 1 day	at head of pass
1894	*Loango*	steamship	grounded for 36 hrs; pulled off by tug	800 ft of W end of jetties
1894	*Darlington*	steamship	grounded for 12 hrs	W of jetties
1895	*Marie Vizen*	bark	struck lump; sank and abandoned	1,500 ft S of W jetty light
1896	*Alberta*	steamship	grounded for 4 days and 5 hrs	W side of jetties by west light
1896	*Jerome*	steamship	grounded for 24 hrs	2 mi below head of pass
1897	*Louisiana*	steamship	grounded 60 hrs; pulled off by tugs	1,000 ft beyond end of W jetty
1897	*Princepessa Christiana*	steamship	grounded for 17 hrs	entering the jetties
1897	*Gottfried Schenker*	steamship	grounded twice on shoal for 3 days; jettisoned cargo; pulled off by tugs	entering the jetties
1898	*Breakwater*	steamship	sheered across mouth of channel and hit jetty; stranded 3 days	landed on top of W jetty

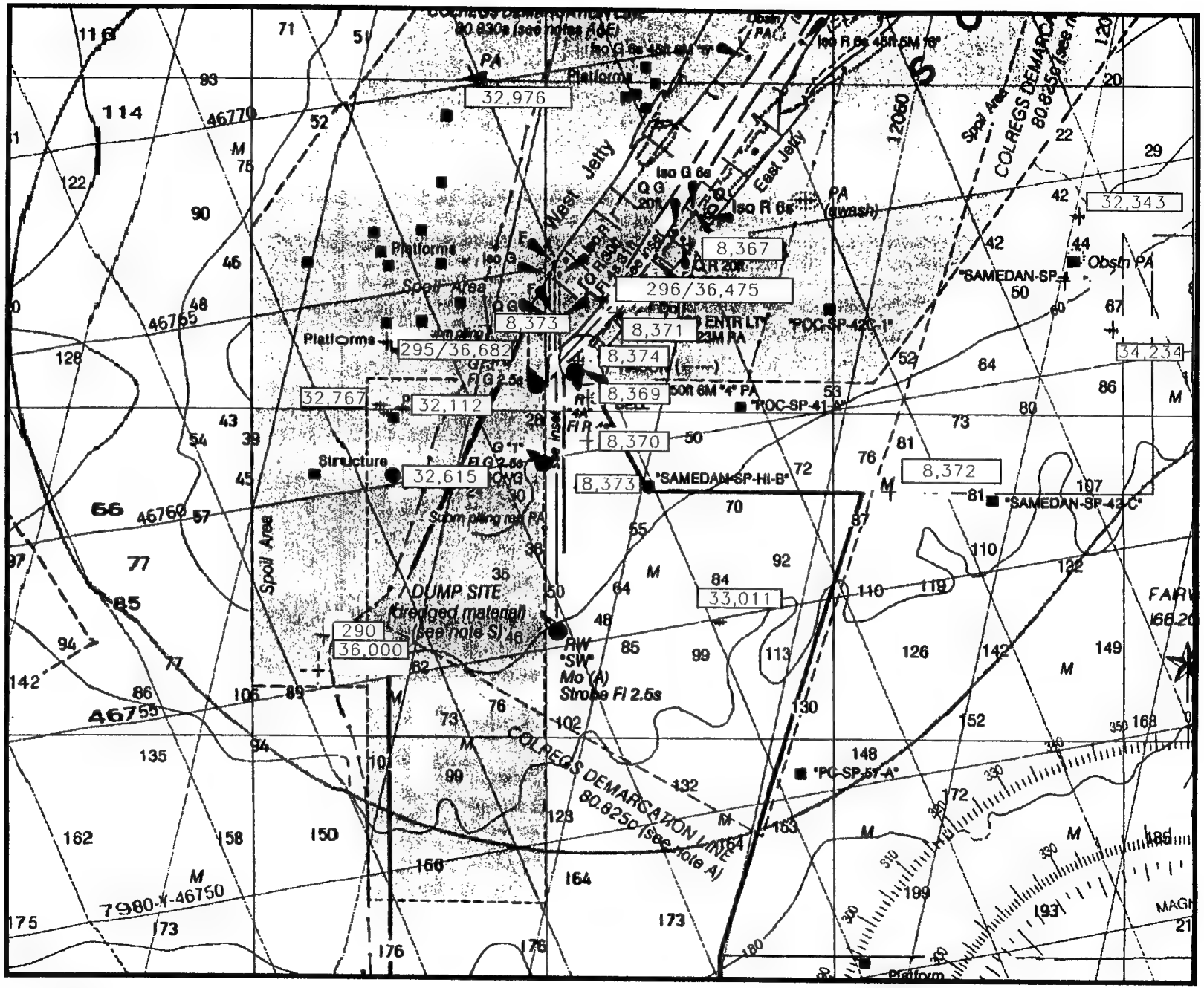


Figure 3. Map indicating AWOIS and NIMA numbered vessel wrecks in Gulf waters around the mouth of Southwest Pass. National Oceanic and Atmospheric Administration and National Image and Mapping Agency, 1999.

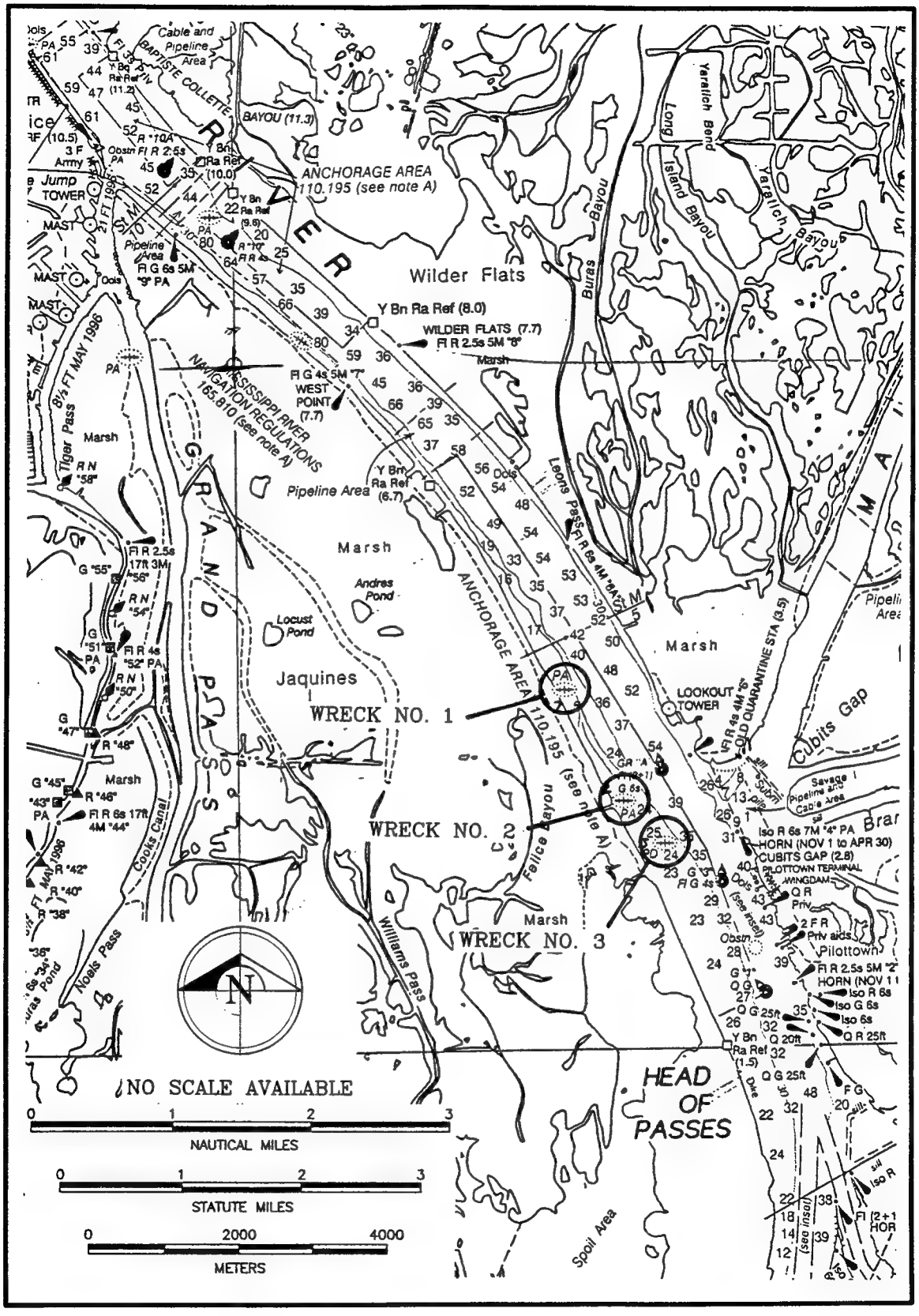


Figure 4. Excerpt from NOAA nautical Chart No. 11361 showing location of wreck no. 1, wreck no. 2, and wreck no. 3 along the west side of the project area. National Oceanic and Atmospheric Administration, Washington, D.C. 1999.

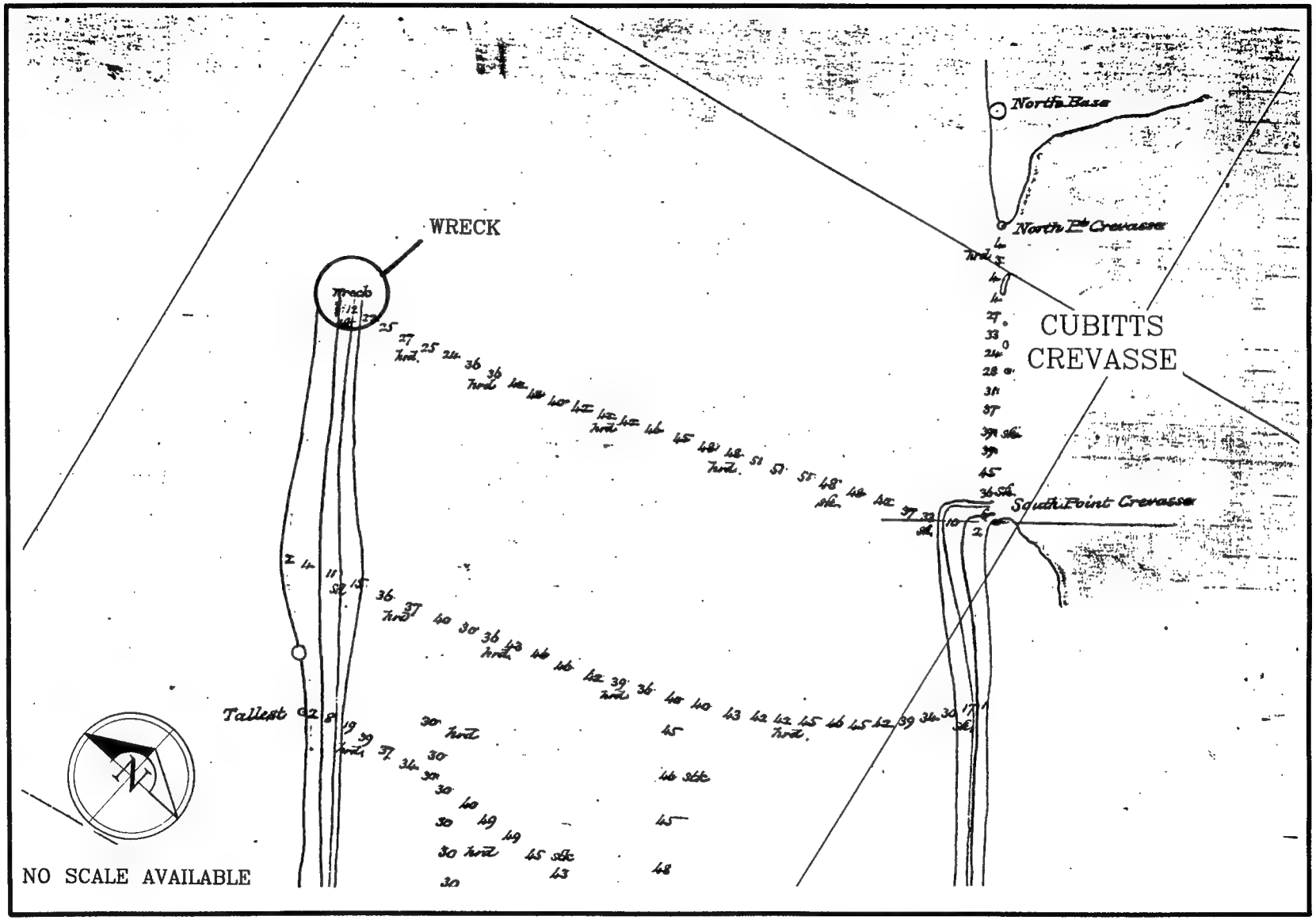


Figure 5. Excerpt from Office of Chief of Engineers 1875 map copied from Gerdes 1866 *Hydrography of Part of Mississippi River, Louisiana,* indicating a wreck west of Cubit's Gap.

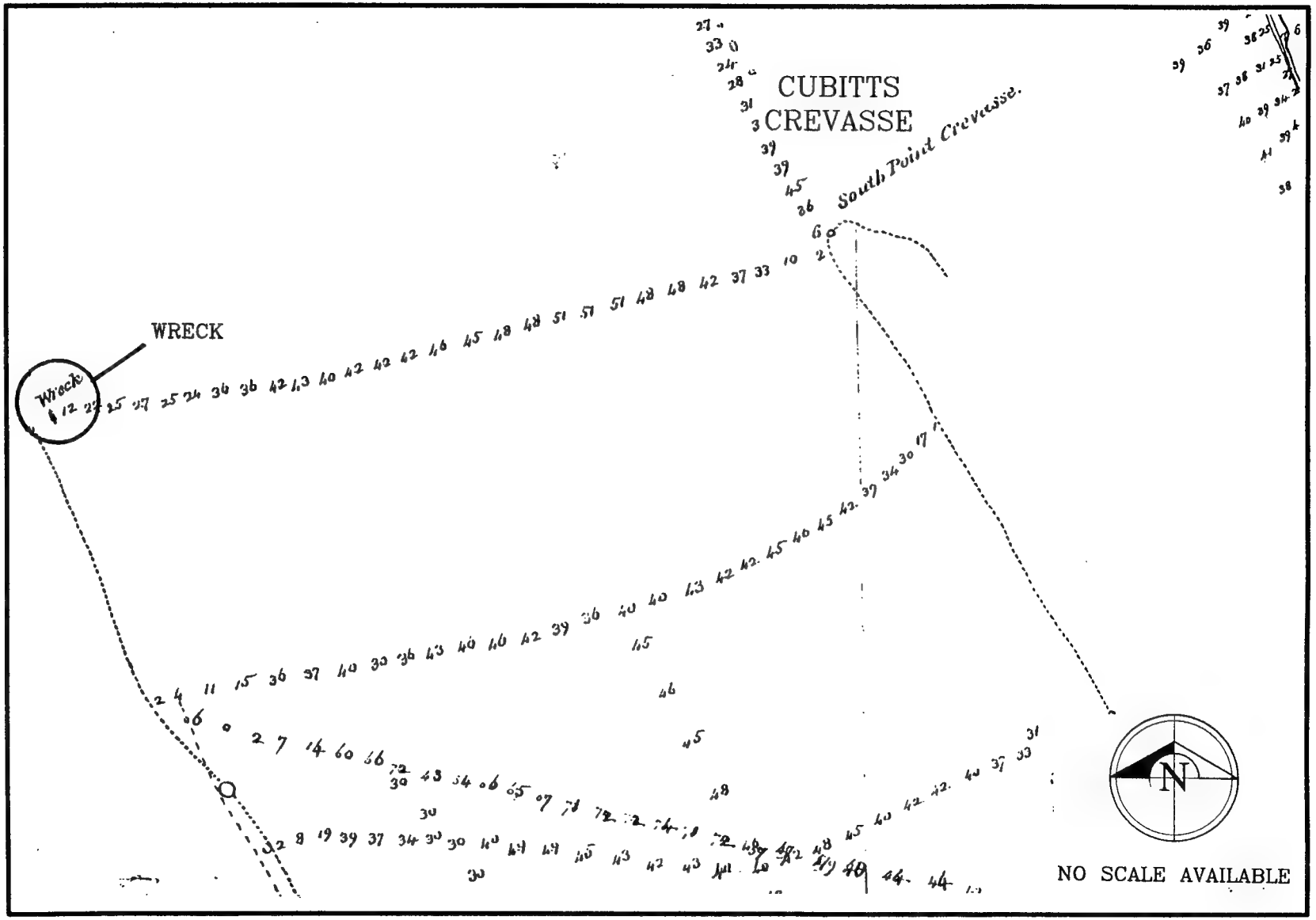


Figure 6.. Excerpt from the map *Head of Passes, Mississippi Delta and Up the River to Cubbitt's Crevasse*, a copy of a previous Coast Survey map. May and June 1875.

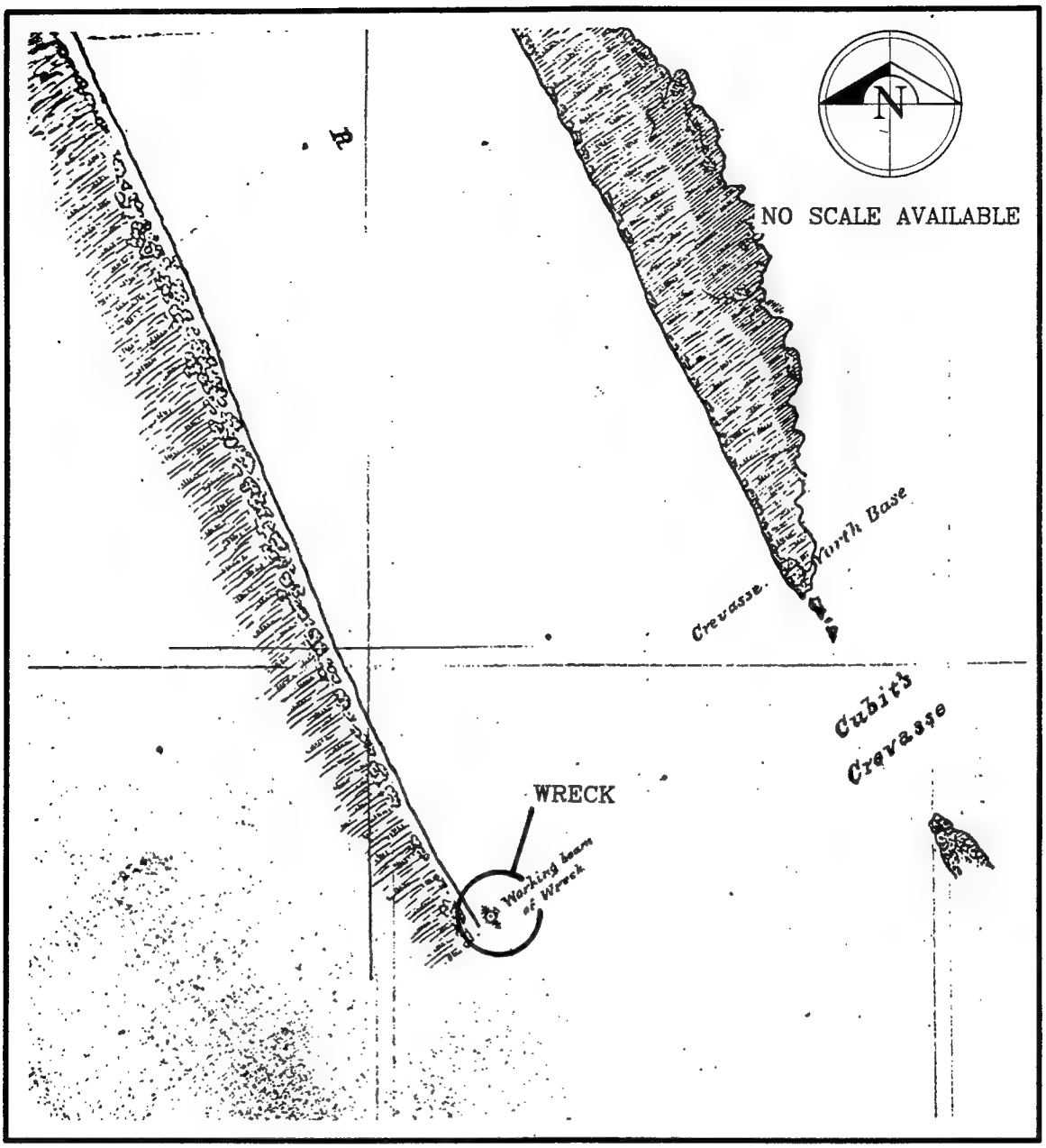


Figure 7. Excerpt from Boyd's 1868 map *Mississippi River from Cubit's Crevasse to the Forts and Shores of Bird Island Sound, La.* U.S. Coast Survey.

at College Park, Maryland, and at the Geography and Map Division, Library of Congress, Washington, D.C. did not unearth any maps or charts earlier than 1866 or later than 1875 that depicted a wreck first indicated in 1866.

A personal communication from James Scarabin of the Venice Office of the Corps of Engineers about the possibility of wrecks across from Cubit's Gap states that the river banks of the Mississippi were rocked in the mid-1960s. During that project no reports were made of any wrecks being found in the area where the Gerdes 1866 map indicates one. Mr. Scarabin, who has lived in the vicinity of the study area, and who worked that section of the river for over 50 years, does not recall ever seeing a wreck in that location (Scarabin, personal communication 2000). Martin Bauer of the United States Army Corps of Engineers confirmed Mr. Scarabin's observation, also through personal communication, stating that the Coast Guard does not have any records that a wrecked vessel is located in that area (Bauer, personal communication 2000).

Historic USGS chart (No. 1272) depicts a wreck close to the eastern bank of the Mississippi River just northwest of Cubit's Gap (Figure 8). The wreck first appears in 1950 and remains depicted until 1957. The Coast Guard's *Aids to Navigation* locates the vessel *La Cache* in the area at 29E 11' 29", 89E 16' 30". The 65 ft long *La Cache* sank in 1992 in 21 ft of water.

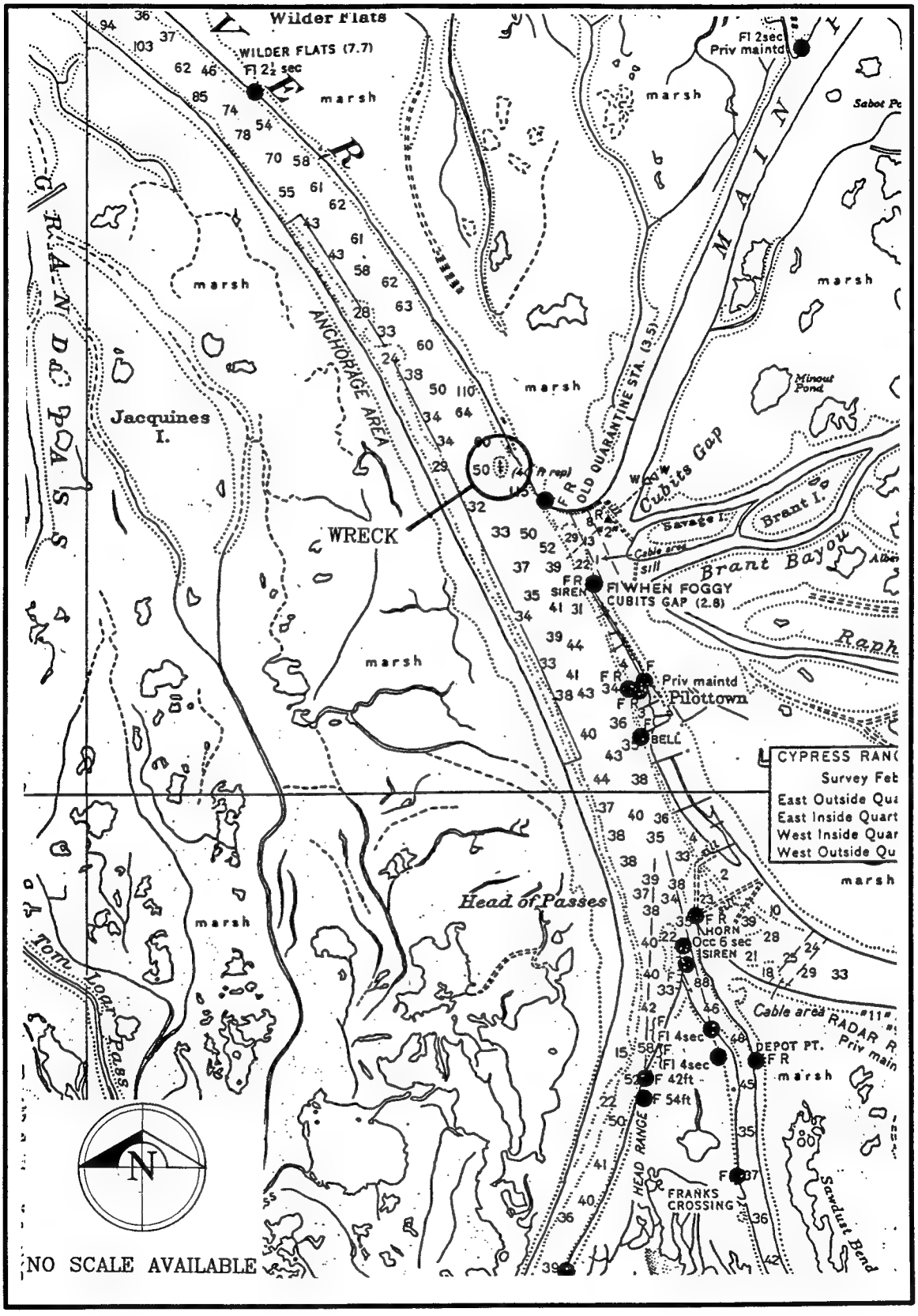


Figure 8. U.S. Coastal and Geodetic Survey 1957 Chart No. 1272, West Delta quad., indicating a wreck northwest of Cubit's Gap.

CHAPTER V

RESEARCH METHODS

Archival Investigations

Archival research for West Bay Diversion, Mississippi Delta, Louisiana project was focused on identifying previously recorded sites of shipwrecks and other obstructions. Literature on shipwrecks, AWOIS (Automated Wreck and Obstruction Information System), U.S. Coast Guard's *Aids to Navigation*, the U.S. Coastal and Geodetic Service nautical charts, historic maps, and U.S. Army Corps of Engineers reports were researched at the Library of Congress in Washington, D.C., and at the National Archives in Washington D.C., and at College Park, Maryland.

Federally produced nautical charts by the National Oceanic and Atmospheric Administration and the United States Geologic Survey are found at the National Archives and Library of Congress. They are surveys of ocean features beginning in the 1860s and continuing to the present. The maps are intended to guide ships through waterways by marking depths, given in fathoms, and buoy positions. The listing of wrecks and other obstructions, such as piles, and dumping areas begins in the 1930s.

Chart No.1007-A, a U.S. Coastal and Geodetic Service map lists sites of World War II sunken vessels in the Gulf of Mexico. Although this chart is titled as containing World War II wreckage, some of the sites are described as having been located in the Gulf before the 1940s. Prepared by the military in 1942, the chart list 51 wrecks. Vessel information on the map includes name, nationality, type of ship, location of sinking, other locations given for the sinking, whether the wreck had a buoy placed over it, depth wreckage lies in, and item number for each vessel.

The following books with lists of shipwrecks also were examined as corroborative evidence for other sources examined for this report:

Beneath the Waters: A Guide to Civil War Shipwrecks (Hemphill 1998);
Encyclopedia of American Shipwrecks (Berman 1972);
A Guide to Sunken Ships in American Waters (Lonsdale and Kaplan 1964);
Merchant Steam Vessels of the United States, 1790-1868 ("The Lytle-Holdcamper List") (Mitchell 1975);
Way's Steam Towboat Directory (Way, Jr., and Rutter 1990);
Wreck List Information (Hydrographic Office, U.S. Navy 1945); and,
Way's Packet Directory, 1848-1994 (Way, Jr. 1983).

Archeological Investigations

West Bay Diversion, Anchorage Area and Cut/Diversion Area marine remote sensing survey was conducted from the 24 ft research vessel *Coli*. *Coli* was leased from the Louisiana Universities Marine Consortium (LUMCON). The survey area for this project consisted of two survey blocks or areas. Block 1 is an area within the Mississippi River, comprising the potential area to be maintained for anchorage. Block 1 is 4 mi long (6,485 m) and 500 ft (152 m) wide. Block 2 is an area also in the Mississippi River and is connected to block 1, but is within the limits of the Cut/Diversion. Block 2 is approximately 4,600 ft (1,402 m) long and 1,239 ft (378 m) wide. The survey was conducted along parallel track lines spaced at 50-ft (15 m) intervals. In total, approximately 67.0 linear miles of river bottom were surveyed. This equals an area of approximately 244 acres in the first survey block and 130.8 acres in the second survey block. The project area is located five miles north from the mouth on the Mississippi River, near Cubits Gap, Louisiana.

The remote sensing survey was designed to identify specific magnetic or acoustic anomalies and/or clusters of anomalies that might represent potentially significant submerged cultural resources, such as shipwrecks. The natural and anthropogenic forces that form such sites typically scatter ferrous objects like fasteners, anchors, engine parts, ballast, weaponry, cargo, tools, and miscellaneous related debris across the river bottom. These objects normally can be detected with a marine magnetometer, side scan sonar system, and fathometer that record anomalous magnetic or acoustic underwater signatures that stand out against the ambient magnetic or visual field. Two critical elements in the interpretation of such anomalies, which may also result from natural or modern sources, are their patterns and, in the case of magnetic anomalies, their amplitude and duration. Because of the importance of anomaly patterning, accurate recording and positioning of anomaly locations is essential.

The equipment array used for the West Bay Diversion survey included a DGPS, a proton precession marine magnetometer, a side scan sonar, and a fathometer (Figure 9). Data were collected and correlated via a laptop computer using hydrographic survey software.

Positioning

A Differential Global Positioning System (DGPS) was used to direct navigation and supply accurate positions of magnetic and acoustic anomalies. The DGPS system consisted of a Northstar 941XD with internal DGPS. The Northstar 941XD transmitted position information in NMEA 0183 code to the computer navigation system (version 7.0 of Coastal Oceanographics' *Hypack* software).

Hypack translates the NMEA message and displays the survey vessel's position on a computer screen relative to the pre-plotted track lines. During post-processing, *Hypack's* positioning files can be utilized to produce track plot maps and to derive the X, Y, and Z values used to produce magnetic and bathymetric contour plot maps. For the West Bay Diversion marine remote sensing survey, positioning control points were obtained continuously by *Hypack* at one-second intervals. During the course of the survey, strong differential signals were acquired with a minimum noise to signal ratio.

Magnetometry

The recording proton precession marine magnetometer is an electronic instrument used to record the strength of the earth's magnetic field in increments of nanoTeslas or gammas. Magnetometers have proven useful in marine research as detectors of anomalous distortions in the earth's ambient magnetic

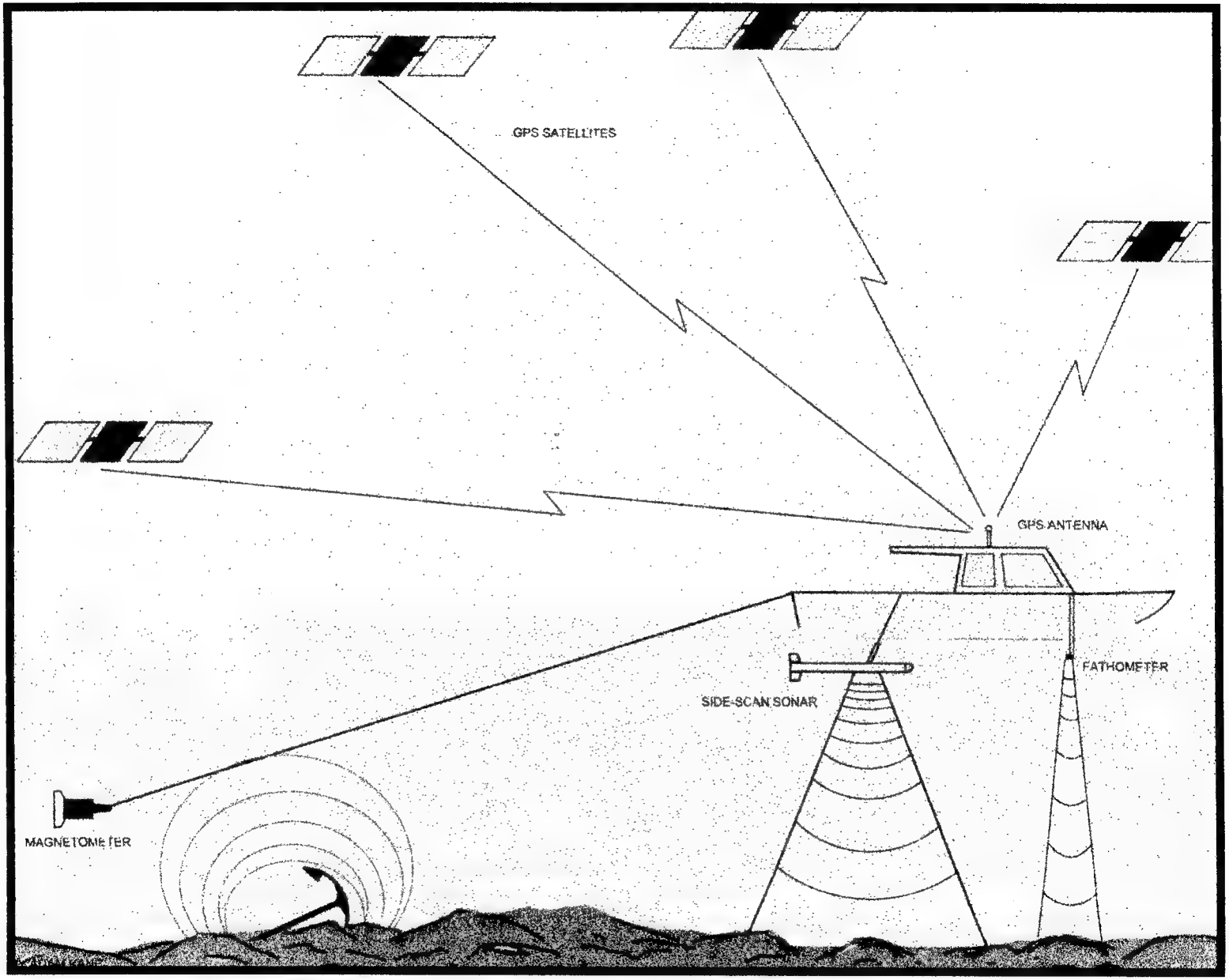


Figure 9. Drawing showing array of remote sensing and positioning equipment utilized during the West Bay Diversion Area survey.

field, particularly distortions that are caused by concentrations of naturally occurring and manmade, ferrous materials. Distortions or changes as small as 0.5 gammas are detectable when operating the magnetometer at a sampling rate of one second. Magnetic distortions caused by shipwrecks may range in intensity from several gammas to several thousand gammas, depending upon such factors as the mass of ferrous materials present, the distance of the ferrous mass from the sensor, and the orientation of the mass relative to the sensor. The uses of magnetometers in marine archeology and the theoretical aspects of the physical principles behind their operation are summarized and discussed in detail in Aitken (1961), Hall (1966, 1970), Tite (1972), Breiner (1973), Weymouth (1986), and Green (1990).

Individual anomalies produce distinctive magnetic "signatures." These individual signatures may be categorized as 1) positive monopole; 2) negative monopole; 3) dipolar or 4)-multi component (Figure 10). Positive and negative anomalies refer to monopolar deflections of the magnetic field and usually indicate a single source. They produce either a positive or negative deflection from the ambient magnetic field, depending on how the object is oriented relative to the magnetometer sensor and whether its positive or negative pole is positioned closest to the sensor. Dipolar signatures display both a rise and a fall above and below the ambient field; they also are commonly associated with single source anomalies, with the dipole usually aligned along the axis of the magnetic field and the negative peak of the anomaly falling nearest the North Pole.

Especially important for archeological surveys are multi-component anomalies. Multi-component or complex signature anomalies consist of both dipolar and monopolar magnetic perturbations associated with a large overall deflection that can be indicative of the multiple individual ferrous materials comprising the debris patterns typically associated with shipwrecks. The complexity of the signature is affected partially by the distance of the sensor from the debris and the quantity of debris. If the sensor is close to the wreck, the signature will be multi component; if far away, it may appear as a single source signature.

A Geometrics G866 proton precession marine magnetometer was used to complete the magnetic survey of the West Bay Diversion project area. The G866 is a 0.1 gamma sensitivity magnetometer that downloads magnetic data in digital format as numeric data files in *Hypack*. As the magnetic data are being collected, *Hypack* attaches the precise real-time DGPS coordinates to each magnetic reading, thus ensuring precise positioning control. The magnetometer was towed far enough behind the survey vessel to minimize the associated noise, which generally measured less than two gammas. A float was attached to the magnetometer sensor, so that a consistent depth below the water's surface could be maintained.

Acoustic Imaging

Over the past 25 years, the combined use of acoustic (sonar) and magnetic remote sensing equipment has proven to be the most effective method of identifying submerged cultural resources and assessing their potential for further research (Hall 1970; Green 1990). When combined with magnetic data, the near photographic-quality acoustic records produced by side scan sonar systems have left little doubt regarding the identifications of some targets that are intact shipwrecks (Figure 11). For targets lacking structural integrity or those partially buried beneath bottom sediments, identification can be extremely difficult. Because intact and exposed wrecks are less common than broken and buried wrecks, remote sensing surveys generally produce acoustic targets that require ground-truthing by divers to determine their identification and historic significance.

An Imagenex color imaging digital side scan sonar system was utilized continuously during the West Bay Diversion survey to produce sonograms of the river bottom on each transect within the project area. The Imagenex system consisted of a Model 858 processor coupled with a Model 855 dual transducer tow fish operating at a frequency of 330 KHz. The sonar was set at a

range of 90 ft per channel, which yielded overlapping coverage of the study areas. Sonar data were recorded in a digital format on a 270 megabyte 3.5 in SyQuest cartridge. A stream of time-tags was attached continuously to the sonar data to assist in post-processing correlation of the acoustic and magnetic data sets. Acoustic images were displayed on a VGA monitor as they were recorded during the survey, and an observation log was maintained by the sonar technician to record descriptions of the anomalies and the times and locations associated with each target. Potential targets were inventoried both during the survey and in post-processing.

The methodology employed during the survey produced favorable results, with reliable DGPS signals, low noise levels on the magnetometer, and clear acoustic images. All positioning and remote sensing equipment performed reliably throughout the survey. Regular and evenly spaced coverage of the entire survey area was achieved.

Survey Control and Correlation of Data Sets

The *Hypack* survey software provided the primary method of control during the survey. Survey lanes were planned in *Hypack*, geodetic parameters were established, and instruments were interfaced and recorded through the computer software. During the survey, the planned survey lines were displayed on the computer screen, and the survey vessel's track was monitored. In addition to providing steering direction for the helmsman, *Hypack* allowed the surveyors to monitor instruments and incoming data through additional windows on the survey screen.

All remote sensing data were correlated with DGPS positioning data and time through *Hypack*. Positions for all data then were corrected through the software for instrument layback and offsets. Positioning was recorded using Louisiana South State Plane grid coordinates, referencing the North American Datum of 1983 (NAD-83). The GRS-1980 ellipsoid was used, along with a Lambert projection.

Remote Sensing Data Analysis

Magnetic and acoustic data were analyzed in the field while they were generated, and post-processed using *Hypack* and Autodesk's *AutoCAD* computer software applications. These computer programs were used to assess the signature, intensity, and duration of individual magnetic disturbances, and to plot their positions within the project area.

In the analysis of magnetometer data for this survey, individual anomalies were identified and carefully examined. First, the profile of each anomaly was characterized in terms of pattern, amplitude, and duration. Magnetic data were correlated with field notes, so that deflections from modern sources, such as channel markers, could be identified. Although all anomalies with an amplitude greater than ten gammas were given a magnetic anomaly number for reference purposes and tabulate; anomalies of larger amplitude (more than 50 gammas) and of longer duration (more than 20 seconds) generally are considered to have a higher likelihood of representing possible shipwreck remains, especially when such anomalies cluster together.

Side scan sonar data were examined for anomalous acoustic targets and shadows that might represent potentially significant submerged cultural resources, and to correlate with any magnetic or bathymetric anomalies.

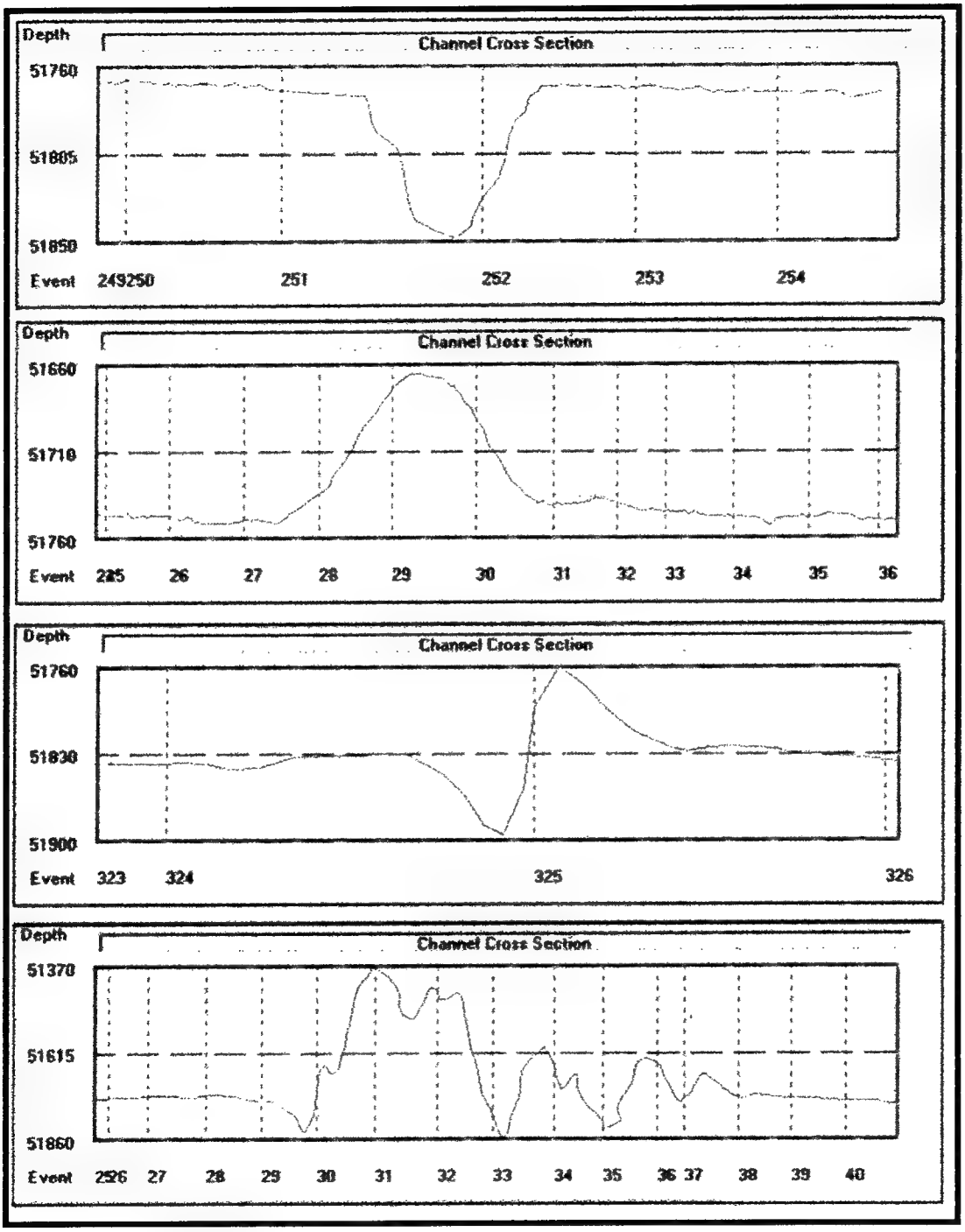


Figure 10. Magnetic Signatures: Positive Monopole, Negative Monopole, Dipole, and Multi-Component.

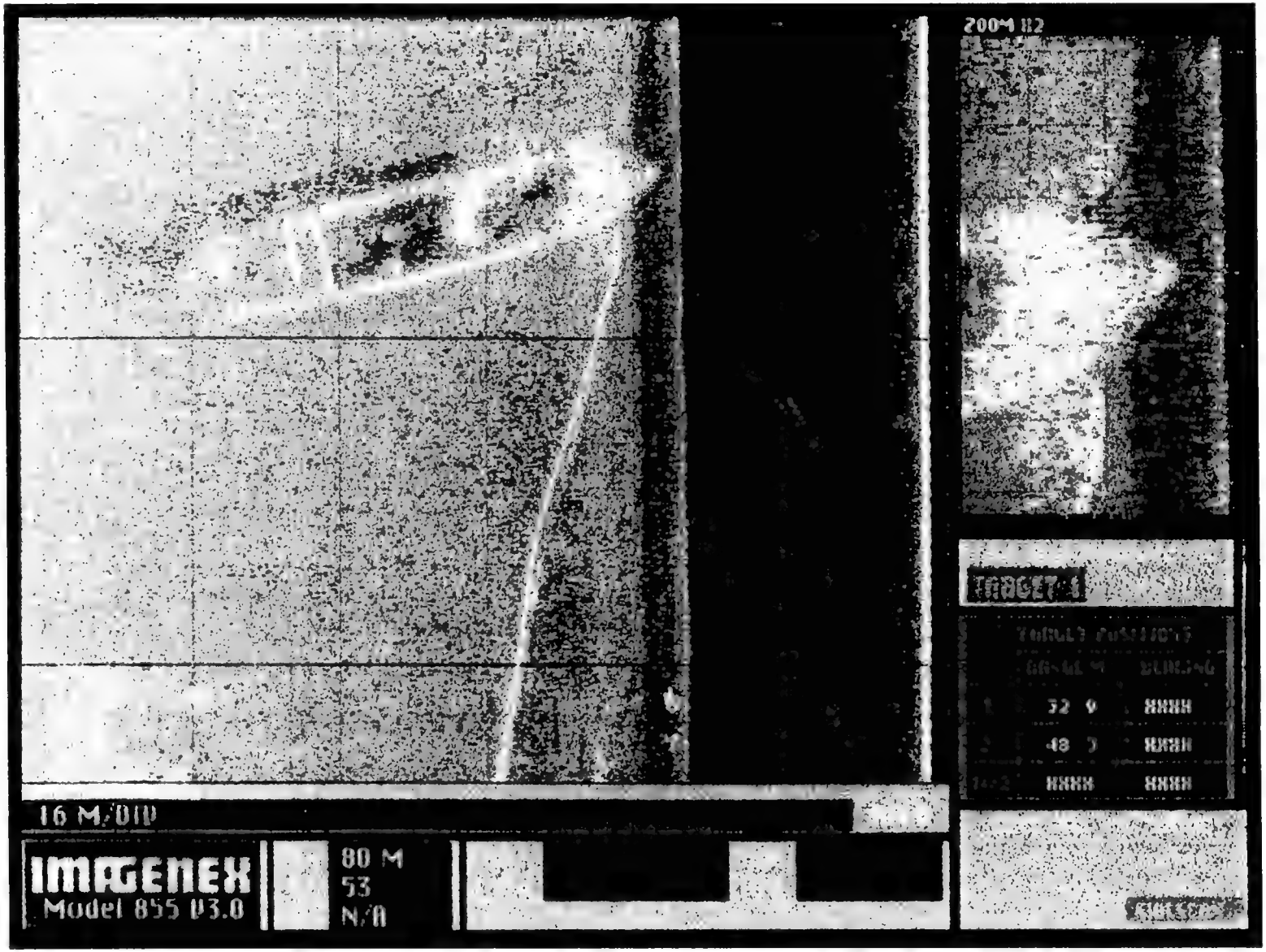


Figure 11. An example of and acoustic image of an intact shipwreck.

CHAPTER VI

RESULTS OF REMOTE SENSING

The following discussion reviews the results of underwater cultural resources survey of the West Bay Diversion Project in the Mississippi River. A general overview is followed by a description of the anomalies located in the survey area, which are divided into four categories: possible shipwreck, anomalies associated with dredged areas, scattered debris, and localized debris. Figures 12a and 12b show the spatial distribution of the magnetic anomalies, acoustic anomalies, and targets. The magnetic anomalies were identified initially by reading individual trackline data sets, and then by analysis of contouring plots.

General Overview of the Survey Results

A total of 128 magnetic anomalies (Table 4) were detected during the West Bay Diversion survey. Additionally, a total of 25 acoustic anomalies (Table 5) were recorded; six of these had corresponding magnetic data. All of the acoustic anomalies appeared to be either areas associated with dredging or modern man-made debris that had washed into the river, fallen off vessels, or that had been discarded.

In the following discussion, 22 targets are described. An assessment of each target's potential for representing a significant submerged cultural resource is presented, and management recommendations for these potential resources are provided. Individual magnetic anomalies are quantified in Table 4; individual acoustic anomalies are qualified in Table 5; targets are identified in Table 6. In considering these anomalies, water depth, lane spacing, magnetic deflection, duration of deflection, and proximity to observed manmade structures were taken into account.

Two targets (Targets 8 and 22) appear to be associated with a modern vessel that is seen on NOAA chart #11361 from 1973 to 1997. The wreck must have occurred between 1967 and 1973; the wreck was not in its mapped position when the riverbank was shored up with rocks by the U.S. Army Corps of Engineers in 1967 (Personal Communication, Jimmy Scarabin, USACE-Venice, LA, February 2000). This possible wreck site is younger than 50 years old; it does not meet the age requirement for listing in the National Register of Historic Places. In addition, the geophysical data indicate that the vessel remains are disarticulated and widely scattered; the vessel remains lack integrity. No further study is recommended for Targets 8 and 22.

Specific Target Analyses

Possible Shipwreck

Target #8. Four magnetic anomalies (M102, M103, M106, and M110) comprise Target #8 (Figure 13). This target is located along the western edge of the Cut/Diversion Project Area (Block 2 of remote sensing survey). The southern end of the target has the highest gamma readings, with M102 exhibiting 230 gammas and M103 having 50 gammas; both anomalies are positive monopoles with short-to-medium durations of 11 seconds and 10 seconds, respectively. M106 has a low amplitude of 20 gammas; M110 also has a low amplitude of 25 gammas. Both anomalies have dipolar signatures. They also have short durations of 11 seconds and 9 seconds, respectively. Analysis of the magnetometer and acoustic data obtained in this survey suggest that the target either is a buried, disarticulated modern vessel or remnants from its possible salvage. No acoustic images were detected to indicate a vessel; however, NOAA chart #11361 shows a wreck identified near this target.

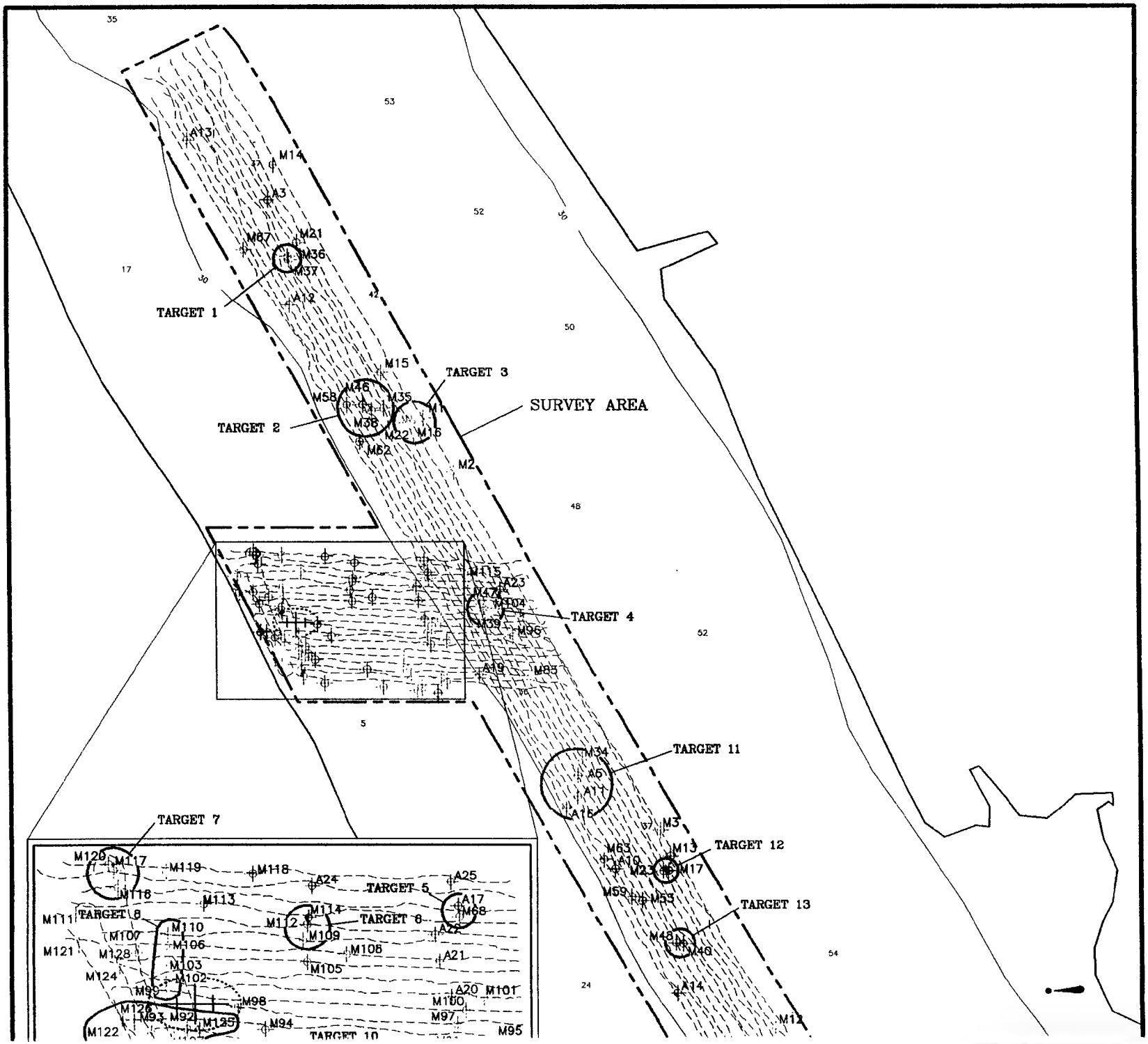
Target #22. Target #22 comprises seven magnetic anomalies (M92, M93, M122, M123, M125, M126, M127) (Figure 14). Most of these anomalies exhibit low-to-medium gamma signatures, between 20 and 65, with short durations of between 3 seconds and 16 seconds. Only one anomaly (M127) had a high gamma reading of 110, with a short duration of 7 seconds. This target also is situated near the wreck identified on N0AA chart #11361, on the western edge of the Cut/Diversion Project Area (Block 2 of remote sensing survey). No acoustic images were detected to indicate a vessel; again, the NOAA chart #11361 shows a wreck identified near this target.

Dredging Areas

Target #11. This target is located in the center of the Anchorage Area along the northern section of the survey area (Block 1 of the remote sensing survey). One magnetic anomaly (M34) and three acoustic anomalies (A5, A11, and A16) comprise Target #11. M34 consists of a small amplitude disturbance of 27.5 gammas, with a dipolar signature and medium duration of 31 seconds (Figure 15). The acoustic anomalies (A5 and A11) are indicative of areas associated with dredging (Figure 16, 17, and 18). These anomalies appear to be long linear banks of marine sediment built up from dredging activities. The corresponding magnetic disturbance that is associated with this target probably is a small area of scattered modern debris that was caught within the linear bank of sediment. This target is not indicative of significant cultural resources or a shipwreck. No further study of this target is recommended or warranted.

Target #16. This target is located along the western edge of the survey area in Block 1of the remote sensing survey (Anchorage Area). Target #16 comprises two acoustic anomalies (A6 and A8). The target appears to be associated with a catchment area created by dredging activities (Figures 19 and 20). The long linear lines identified during the survey represent built up marine sediment that was formed during dredging. No magnetic anomalies were detected for this target. Target #16 is not indicative of signatures that represent significant cultural resources or a shipwreck. No further study of the target is recommended or warranted.

Target #17. One magnetic anomaly (M65) and one acoustic anomaly (A7) comprise Target #17. The target is located along the western edge of the Anchorage Area and remote sensing survey area (Block 1). M65 constitutes a dipolar signature of low amplitude of 26 gammas, with a medium duration of 27 seconds. A7 shows a long linear area associated with dredging. The corresponding magnetic anomaly associated with the dredged area probably is a small piece of modern debris (Figure 21). These anomalies are not indicative of significant cultural resources or a shipwreck. Therefore, no further study of the target is recommended or warranted.


TARGET 1
TARGET 2
TARGET 3
SURVEY AREA
TARGET 4
TARGET 5
TARGET 6
TARGET 7
TARGET 8
TARGET 10
TARGET 11
TARGET 12
TARGET 13
M1
M2
M3
M12
M13
M14
M15
M16
M17
M21
M22
M34
M35
M36
M37
M39
M40
M46
M47
M48
M52
M53
M58
M59
M62
M63
M83
M85
M86
M87
M92
M93
M94
M95
M96
M97
M98
M99
M100
M101
M102
M103
M104
M105
M106
M107
M108
M109
M110
M111
M112
M113
M114
M115
M116
M117
M118
M119
M120
M121
M122
M123
M124
M125
M126
M128
A3
A5
A10
A11
A12
A14
A15
A16
A17
A19
A20
A21
A22
A23
A24
A25
35
53
52
50
48
42
37
30
17
5
24
54
57

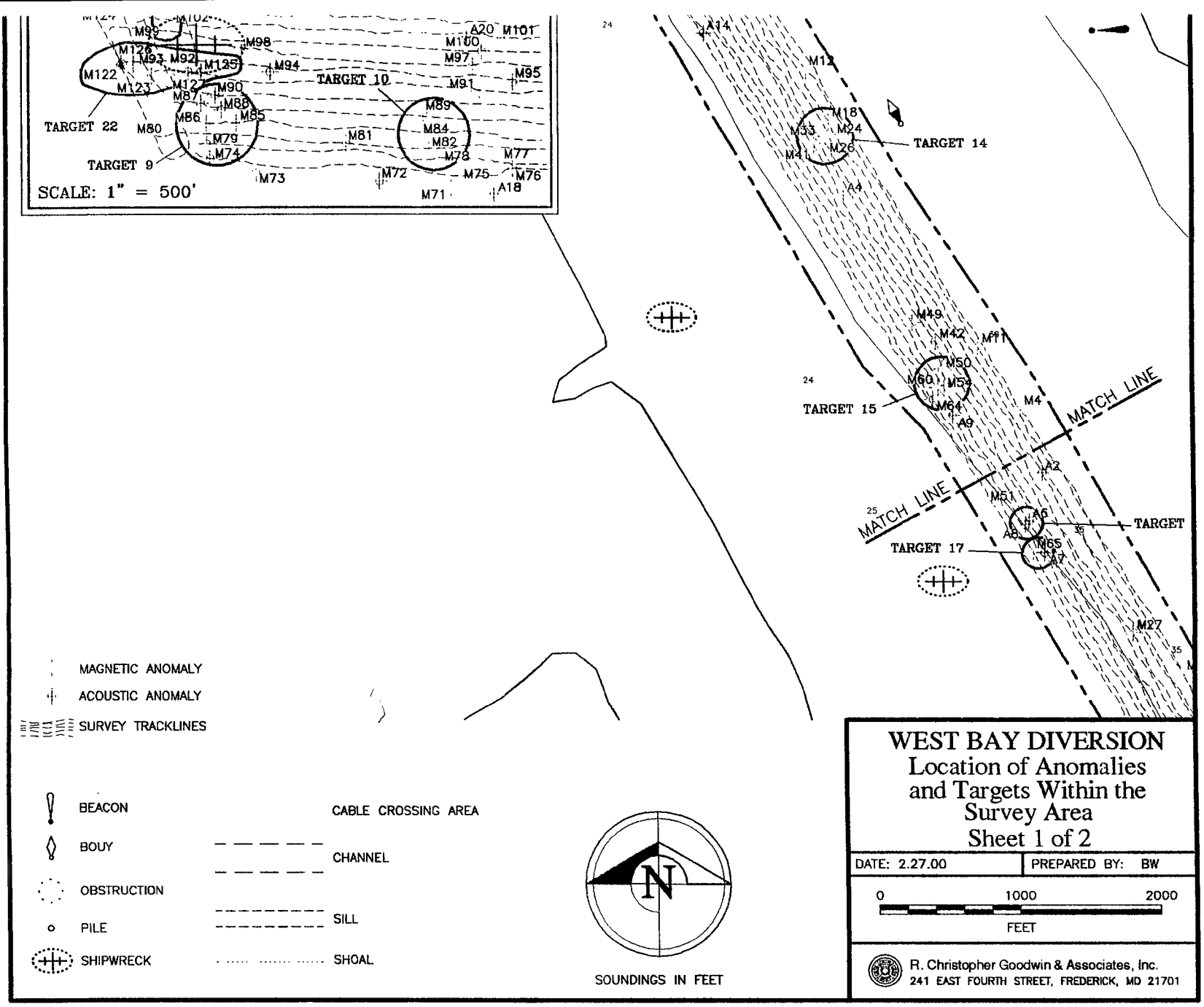
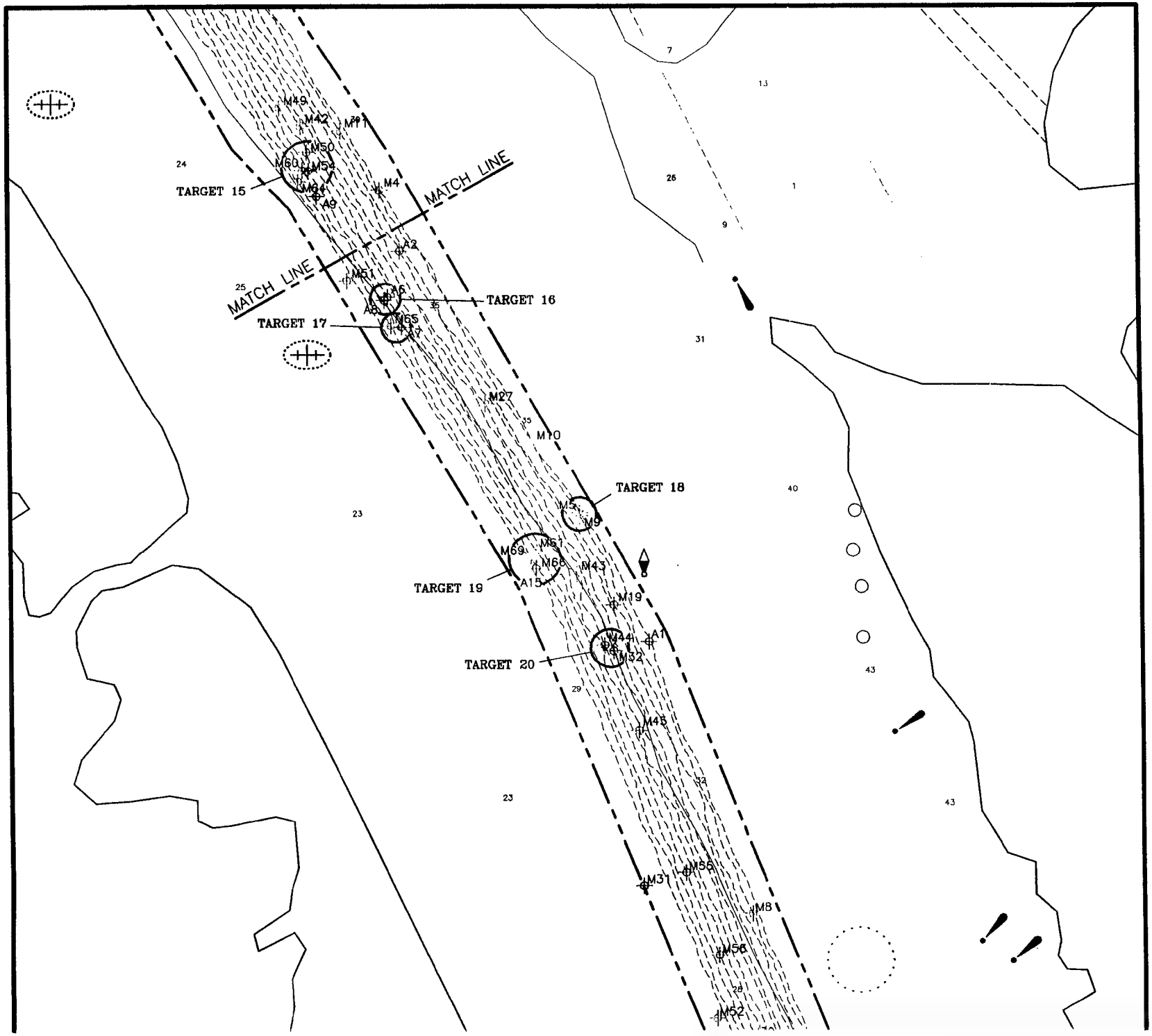


Figure 12a. Location of Anomalies within Survey Area Sheet 1.


TARGET 15
TARGET 16
TARGET 17
TARGET 18
TARGET 19
TARGET 20
MATCH LINE
MATCH LINE
M49
M42
M50
M60
M54
M64
A9
M4
A2
M61
A6
A8
M65
A7
M27
M10
M5
M9
M69
M67
M66
M43
A15
M19
M44
A1
M52
M45
M31
M55
M8
M56
M52
7
13
24
26
1
9
25
35
31
40
23
43
29
32
23
43
28

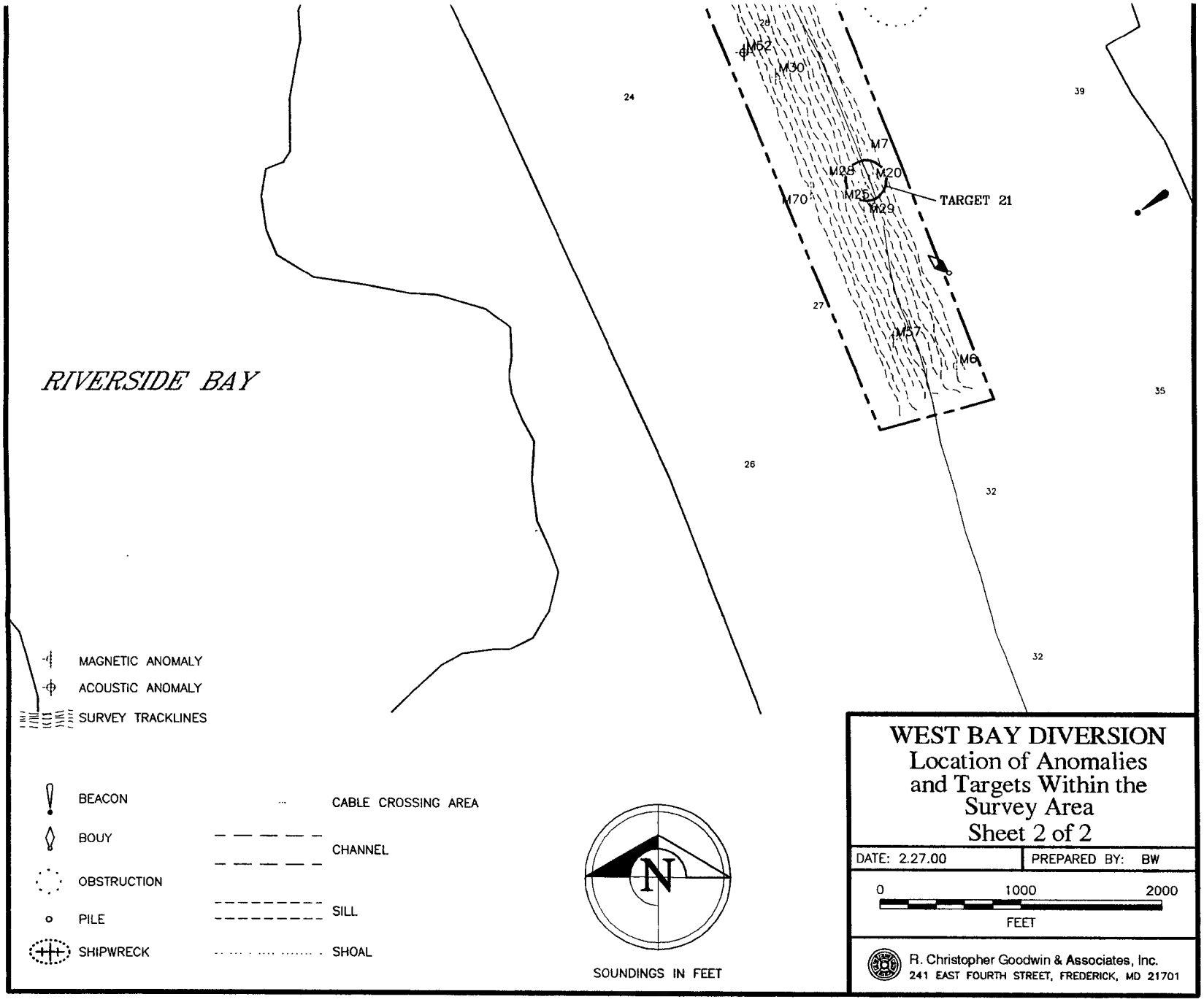


Figure 12b. Location of Anomalies within Survey Area Sheet 2.

Table 4. Master Magnetic Anomaly List for Blocks 1 and 2 of West Bay Diversion Project

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
M1	1	1	2/15/00	11:06:08	11:05:29	12.5	D	0:00:39	3933997.1	266050.2	
M2	1	1	2/15/00	11:07:09	11:06:29	16	D	0:00:40	3934221.8	265642.7	
M3	1	1	2/15/00	11:13:29	11:11:19	29	MC	0:02:10	3935758.6	262923.9	
M4	1	1	2/15/00	11:22:30	11:21:27	11.5	+	0:01:03	3938122.4	258956.3	
M5	1	1	2/15/00	11:27:58	11:27:12	20	D	0:00:46	3939612.4	256503.6	pipe debris
M6	1	2	2/15/00	11:52:14	11:51:51	61	-	0:00:23	3942131.1	250401.9	possble ground tackle
M7	1	2	2/15/00	11:55:30	11:55:01	62.5	D	0:00:29	3941493.8	251940.8	
M8	1	2	2/15/00	11:58:56	11:58:09	17	MC	0:00:47	3940889.8	253461.9	
M9	1	2	2/15/00	12:05:09	12:04:36	20.5	D	0:00:33	3939612.1	256481.6	
M10	1	2	2/15/00	12:06:18	12:05:59	14	+	0:00:19	3939267.6	257040.7	
M11	1	2	2/15/00	12:12:11	12:11:56	15.5	+	0:00:15	3937826.7	259406.8	
M12	1	2	2/15/00	12:41:22	12:40:03	39	-	0:01:19	3936617	261395.3	
M13	1	2	2/15/00	12:44:07	12:43:35	14.5	-	0:00:32	3935834.1	262729.4	
M14	1	2	2/15/00	13:34:15	13:33:12	87	-	0:01:03	3932866.4	267976.8	
M15	1	3	2/15/00	13:43:17	13:42:40	19	+	0:00:37	3933680.8	266392.1	
M16	1	3	2/15/00	13:43:57	13:43:33	15.5	-	0:00:24	3933905.9	266010.6	
M17	1	3	2/15/00	13:51:02	13:49:59	67.5	D	0:01:03	3935821.1	262619.4	
M18	1	3	2/15/00	13:53:45	13:52:23	33.5	-	0:01:22	3936772.7	261034.3	
M19	1	3	2/15/00	14:04:58	14:03:13	41.5	-	0:01:45	3939862.4	255805.5	Large tanker going by
M20	1	3	2/15/00	14:12:38	14:12:10	36	MC	0:00:28	3941530.2	251741.6	possible pipe debris
M21	1	4	2/15/00	14:57:56	14:57:27	39	-	0:00:29	3933046.8	267384.3	
M22	1	4	2/15/00	14:54:52	14:54:29	24	-	0:00:23	3933868.5	266013	
M23	1	4	2/15/00	14:47:43	14:46:53	41	D	0:00:50	3935781.1	262617.7	
M24	1	4	2/15/00	14:44:15	14:43:25	128.5	D	0:00:50	3936771.8	260945.6	
M25	1	4	2/15/00	14:24:39	14:24:15	46.5	D	0:00:24	3941471.3	251735.9	
M26	1	5	2/15/00	15:23:20	15:22:37	184	D	0:00:43	3936746.8	260878.4	
M27	1	5	2/15/00	15:31:16	15:30:49	23.5	D	0:00:27	3938912.6	257333.5	
M28	1	5	2/15/00	15:43:34	15:42:42	20.5	MC	0:00:52	3941422.3	251742.5	visible debris

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
M29	1	6	2/15/00	15:50:43	15:50:24	18	+	0:00:19	3941466.2	251494	
M30	1	6	2/15/00	15:54:29	15:52:53	33.5	-	0:01:36	3940845.5	252483	
M31	1	6	2/15/00	15:57:51	15:57:05	22	D	0:00:46	3940072	253674.6	
M32	1	6	2/15/00	15:58:58	15:58:31	21	D	0:00:27	3939858.4	255454.4	
M33	1	6	2/15/00	16:11:25	16:10:08	121	D	0:01:17	3936700.3	260887.9	
M34	1	6	2/15/00	16:17:14	16:16:43	27.5	D	0:00:31	3935173.6	263453.1	visible debris
M35	1	6	2/15/00	16:23:25	16:22:47	32	D	0:00:38	3933699.7	266122	visible debris
M36	1	6	2/15/00	16:26:01	16:25:32	28.5	D	0:00:29	3932978.5	267277.8	
M37	1	7	2/15/00	16:37:24	16:36:55	22.5	D	0:00:29	3932985.5	267251.1	
M38	1	7	2/15/00	16:39:52	16:39:17	28	D	0:00:35	3933608	266102.6	
M39	1	7	2/15/00	16:43:08	16:41:53	20	MC	0:01:15	3934475.2	264585.9	
M40	1	7	2/15/00	16:48:46	16:47:26	22.5	D	0:01:20	3935924.7	262061.2	
M41	1	7	2/15/00	16:51:47	16:50:13	52	D	0:01:34	3936669.9	260859	
M42	1	7	2/15/00	16:54:48	16:53:01	26.5	D	0:01:47	3937526.1	259439.5	
M43	1	7	2/15/00	17:02:04	17:01:36	15.5	D	0:00:28	3939589.6	256042.2	
M44	1	7	2/15/00	17:03:07	17:02:48	17	-	0:00:19	3939790.8	255499.4	
M45	1	7	2/15/00	17:04:41	17:04:07	20	D	0:00:34	3940045.6	254851.3	
M46	1	8	2/15/00	17:51:29	17:50:47	15.5	MC	0:00:42	3933540.5	266148.6	
M47	1	8	2/15/00	17:48:06	17:47:19	17.5	MC	0:00:47	3934412.3	264643.3	
M48	1	8	2/15/00	17:42:26	17:39:39	37.5	D	0:02:47	3935873.2	262068.3	
M49	1	8	2/15/00	17:36:11	17:35:21	21	D	0:00:50	3937363.8	259578.8	
M50	1	8	2/15/00	17:35:08	17:34:44	10.5	+	0:00:24	3937571	259242.6	
M51	1	8	2/15/00	17:34:05	17:33:27	15	+	0:00:38	3937872.7	258264	
M52	1	8	2/15/00	17:22:50	17:21:57	20	D	0:00:53	3940616.5	252654.9	
M53	1	9	2/16/00	12:24:01	12:23:20	24	D	0:00:41	3935619.1	262392.3	
M54	1	9	2/16/00	12:30:51	12:30:30	37	-	0:00:21	3937584.8	259101.6	
M55	1	9	2/16/00	12:42:22	12:41:50	20	D	0:00:32	3940392.5	253774.2	
M56	1	9	2/16/00	12:43:41	12:42:57	22.5	-	0:00:44	3940638.2	253146	
M57	1	9	2/16/00	12:49:24	12:48:31	17.5	+	0:00:53	3941676.2	250593.9	
M58	1	10	2/16/00	13:32:30	13:31:37	18.5	-	0:00:53	3933419.3	266147.9	

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
M59	1	10	2/16/00	13:23:28	13:22:47	23	D	0:00:41	3935540.1	262419.8	
M60	1	10	2/16/00	13:14:47	13:14:22	27	-	0:00:25	3937540.7	259105.7	
M61	1	10	2/16/00	13:07:16	13:06:04	32	MC	0:01:12	3939291.6	256212.5	
M62	1	11	2/16/00	13:47:21	13:46:00	56.5	D	0:01:20	3933513.4	265869.2	
M63	1	11	2/16/00	13:54:32	13:53:01	28.5	D	0:01:32	3935331.7	262705.2	
M64	1	11	2/16/00	14:01:30	14:01:02	27.5	+	0:00:27	3937506.6	259021.4	
M65	1	11	2/16/00	14:03:54	14:03:28	26	D	0:00:27	3938205.8	257922.5	
M66	1	11	2/16/00	14:08:31	14:06:59	54	MC	0:01:32	3939259.2	256138.7	
M67	1	12	2/16/00	15:02:37	15:01:56	159	D	0:00:40	3932643.3	267329.2	
M68	1	12	2/16/00	14:56:33	14:55:51	115	+	0:00:42	3934026.4	264837.1	
M69	1	12	2/16/00	14:36:06	14:34:49	23	D	0:01:17	3939224.4	256173.5	
M70	1	12	2/16/00	14:26:26	14:25:26	22	MC	0:01:00	3941090.4	251662.6	
M71	2	1	2/16/00	15:37:51.0	15:38:06.9	15	D	0:00:16	3933936.8	263981.8	
M72	2	1	2/16/00	15:38:25.0	15:38:39.2	23	+	0:00:14	3933679.5	264007.5	
M73	2	1	2/16/00	15:39:23.2	15:39:34.2	25	+	0:00:11	3933234.1	264035.9	
M74	2	2	2/16/00	15:40:39.9	15:40:48.1	30	MC	0:00:08	3933069.6	264088.8	
M75	2	2	2/16/00	15:42:13.2	15:42:30.1	20	D	0:00:17	3933971.9	264002.4	
M76	2	2	2/16/00	15:42:41.1	15:42:53.2	20	MC	0:00:12	3934158.6	264052	
M77	2	3	2/16/00	15:48:49.2	15:49:06.2	35	D	0:00:17	3934116.5	264073.1	
M78	2	3	2/16/00	15:49:13.3	15:49:47.3	30	MC	0:00:34	3933891.7	264090.1	
M79	2	3	2/16/00	15:51:08.9	15:51:16.0	60	-	0:00:07	3933056.9	264141.9	
M80	2	4	2/16/00	15:52:05.9	15:52:10.8	90	MC	0:00:05	3932910.4	264170	
M81	2	4	2/16/00	15:53:19.3	15:53:24.8	30	+	0:00:05	3933557.7	264144.3	
M82	2	4	2/16/00	15:53:46.2	15:53:58.8	80	+	0:00:13	3933858.5	264119.4	
M83	2	4	2/16/00	15:55:23.8	15:55:31.0	30	MC	0:00:07	3934793.6	264088.2	
M84	2	5	2/16/00	15:59:55.1	16:00:08.9	150	+	0:00:14	3933829.5	264167.8	
M85	2	5	2/16/00	16:01:17.3	16:01:27.1	25	+	0:00:10	3933163.1	264216.5	
M86	2	5	2/16/00	16:01:31.0	16:01:34.9	90	+	0:00:04	3933056.4	264215.3	
M87	2	6	2/16/00	16:11:24.2	16:11:31.3	45	+	0:00:07	3933035.6	264286.6	
M88	2	6	2/16/00	16:11:35.1	16:11:45.0	70	D	0:00:10	3933110	264263.6	

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
M89	2	6	2/16/00	16:12:52.9	16:13:14.3	20	-	0:00:21	3933838.3	264252.4	
M90	2	7	2/16/00	16:21:20.1	16:21:35.3	70	MC	0:00:15	3933088.9	264316.2	
M91	2	8	2/16/00	16:37:09.2	16:37:20.1	10	-	0:00:11	3934040.5	264332.2	
M92	2	8	2/16/00	16:39:06.2	16:39:22.2	20	+	0:00:16	3932991.3	264401.4	
M93	2	9	2/16/00	16:40:02.1	16:40:07.0	65	+	0:00:05	3932792.6	264427.7	possibly associated with modern wreck (NOAA chart#11361)
M94	2	9	2/16/00	16:40:49.2	16:41:11.1	50	MC	0:00:22	3933286.5	264400.1	
M95	2	9	2/16/00	16:42:28.4	16:42:40.4	20	MC	0:00:12	3934160.6	264363.9	
M96	2	10	2/16/00	16:46:13.4	16:46:33.3	10	D	0:00:20	3934661	264395.4	
M97	2	10	2/16/00	16:47:54.4	16:48:22.4	30	-	0:00:28	3934016.8	264419.7	
M98	2	10	2/16/00	16:50:09.6	16:50:17.3	10	+	0:00:08	3933183.5	264486.9	
M99	2	11	2/16/00	16:52:56.4	16:53:07.3	360	+	0:00:11	3932916.2	264557.4	possibly associated with modern wreck (NOAA chart#11361)
M100	2	11	2/16/00	16:55:00.3	16:55:23.4	40	D	0:00:23	3934049.3	264474.4	
M101	2	12	2/16/00	16:59:47.4	17:00:08.2	25	+	0:00:21	3934117.4	264524.5	
M102	2	12	2/16/00	17:02:26.4	17:02:37.3	230	+	0:00:11	3932909.4	264593.9	possibly associated with modern wreck (NOAA chart#11361)
M103	2	13	2/16/00	17:10:52.4	17:11:02.3	50	+	0:00:10	3932913.8	264624.3	possibly associated with modern wreck (NOAA chart#11361)
M104	2	14	2/16/00	17:12:51.5	17:13:07.4	10	+	0:00:16	3934496.7	264600.6	
M105	2	14	2/16/00	17:15:21.2	17:15:31.6	10	D	0:00:10	3933448.1	264664.1	
M106	2	14	2/16/00	17:16:29.7	17:16:40.7	20	D	0:00:11	3932925.9	264702.6	
M107	2	15	2/16/00	17:17:47.4	17:17:56.7	20	-	0:00:09	3932694.5	264735.1	
M108	2	15	2/16/00	17:19:21.7	17:20:00.5	20	+	0:00:39	3933599	264693.2	
M109	2	16	2/16/00	17:26:46.4	17:27:16.5	50	D	0:00:30	3933432	264748.7	
M110	2	16	2/16/00	17:27:58.8	17:28:07.6	25	D	0:00:09	3932919.7	264770.4	

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
M111	2	17	2/16/00	17:29:11.7	17:29:18.2	700	+	0:00:07	3932574.7	264850.7	
M112	2	17	2/16/00	17:30:49.3	17:31:06.3	240	D	0:00:17	3933448.8	264809.2	
M113	2	18	2/17/00	12:34:50.2	12:35:16.4	15	D	0:00:26	3933055.8	264887.6	
M114	2	18	2/17/00	12:35:45.5	12:36:14.6	90	D	0:00:29	3933454.4	264835.5	
M115	2	19	2/17/00	12:40:57.3	12:41:12.6	20	+	0:00:15	3934322.8	264831.3	
M116	2	19	2/17/00	12:45:04.4	12:45:20.2	90	-	0:00:16	3932731.6	264948.4	
M117	2	20	2/17/00	12:46:43.5	12:47:17.4	210	+	0:00:34	3932716.8	265014.5	
M118	2	21	2/17/00	12:55:48.4	12:56:04.3	70	-	0:00:16	3933242.6	265002.4	
M119	2	21	2/17/00	12:56:34.5	12:56:42.2	155	+	0:00:08	3932914	265012.2	
M120	2	21	2/17/00	12:57:00.2	12:57:11.7	160	+	0:00:12	3932697.9	265038.7	
M121	2	*PL	2/17/00	14:00:29.0	14:00:40.5	50	+	0:00:11	3932586.3	264731	
M122	2	*PL	2/17/00	14:01:13.8	14:01:18.7	60	-	0:00:05	3932747.7	264425.8	
M123	2	*PL	2/17/00	14:02:52.5	14:03:00.7	35	D	0:00:08	3932856.7	264385.5	
M124	2	*PL	2/17/00	14:03:25.9	14:03:37.9	40	D	0:00:12	3932739.8	264644.6	
M125	2	*PL	2/17/00	14:10:21.5	14:10:27.6	35	+	0:00:06	3933036.8	264400.7	
M126	2	*PL	2/17/00	14:05:14.8	14:05:17.6	25	+	0:00:03	3932749.4	264431.9	
M127	2	*PL	2/17/00	14:06:58.8	14:07:05.5	110	D	0:00:07	3932930.9	264380.6	possibly associated with modern wreck (NOAA chart#11361)
M128	2	*PL	2/17/00	14:07:39.9	14:07:49.8	270	D	0:00:10	3932810.3	264698.2	
*Line PL indicates parallel lines running N-S in Block 2											

Table 5. Master Acoustic Anomaly List for Blocks 1 and 2

Anom#	Block#	%	Line	Date	Time (begin)	Time (end)	Offset	Latitude	Longitude	X (North)	Y (West)	Description
A1	1	0%	1	15-Feb-00	12:28:37	12:28:46	100' port	29°11.177 N	89°16.033 W	3940124.9	255527.3	Buoy #3
A2	1	11%	4	15-Feb-00	15:37:07	15:37:16	151' port	29°11.671 N	89°16.371 W	3938273.7	258488.5	rectangular object, approx 30' of it then goes in mud
A3	1	13%	5	15-Feb-00	16:06:50	16:07:39	120' to 160' port	29°13.208 N	89°17.364 W	3932827.5	267708	possible barge, could be a tree
A4	1	23%	7	15-Feb-00	17:50:21	17:50:21	120' port	29°12.006 N	89°16.627 W	3936876	260494.1	small debris field
A5	1	27%	8	15-Feb-00	18:43:16	18:43:39	60' to 160' port	29°12.480 N	89°16.944 W	3935139.1	263336.3	scattering of debris
A6	1	30%	9	16-Feb-00	13:31:34	13:31:39	75' to 140' port	29°11.614 N	89°16.390 W	3938178.9	258141.3	scattering of debris
A7	1	34%	10	16-Feb-00	14:10:08	14:10:08	starboard	29°11.576 N	89°16.371 W	3938284	257912.8	pipeline
A8	1	34%	10	16-Feb-00	14:10:41	14:10:41	starboard	29°11.610 N	89°16.395 W	3938152.7	258116.6	pipeline
A9	1	34%	10	16-Feb-00	14:12:52	14:12:52	starboard	29°11.742 N	89°16.488 W	3937643.8	258907.6	pipeline/cable
A10	1	35%	10	16-Feb-00	14:22:21	14:22:39	48' to 95' stbd	29°12.363 N	89°16.894 W	3935417.6	262632.1	Debris w/ mag hit corr. Possible wreck
A11	1	35%	10	16-Feb-00	14:23:51	14:23:51	starboard	29°12.454 N	89°16.945 W	3935136.6	263178.6	Pipeline E/W orientation
A12	1	36%	10	16-Feb-00	14:32:45	14:32:45	91' starboard	29°13.075 N	89°17.336 W	3932990.7	266904.7	Pipeline E/W orientation

Anom#	Block#	%	Line	Date	Time (begin)	Time (end)	Offset	Latitude	Longitude	X (North)	Y (West)	Description
A13	1	36%	11	16-Feb-00	14:40:37	14:40:37	76.8' starboard	29°13.285 N	89°17.478 W	3932213.1	268163.8	Pipeline E/W orientation
A14	1	38%	11	16-Feb-00	14:54:28	14:54:37	47' to 56' port	29°12.204 N	89°16.810 W	3935881.5	261676.5	Debris, piece of pipe
A15	1	39%	11	16-Feb-00	15:06:22	15:06:30	40' port	29°11.271 N	89°16.189 W	3939285.1	256082	scattered debris with mag hit
A16	1	43%	12	16-Feb-00	15:51:08	15:51:08	90' to 140' port	29°12.440 N	89°16.961 W	3935053.1	263092.3	Oval shape with hole in center
A17	1	43%	12	16-Feb-00	15:55:07	15:55:27	95' to 130' port	29°12.738 N	89°17.149 W	3934021.3	264880.3	scattered debris
A18	2	45%	1	16-Feb-00	16:36:24	16:36:30	92' to 100' stbd	29°12.586 N	89°17.139 W	3934090.9	263960.1	possible section of pipe
A19	2	46%	4	16-Feb-00	16:53:37	16:53:47	120' to 130' port	29°12.608 N	89°17.080 W	3934402.2	264099	possible cable
A20	2	50%	12	16-Feb-00	17:58:59	17:59:11	75' port	29°12.680 N	89°17.155 W	3933995.7	264528.2	Debris field
A21	2	51%	15	16-Feb-00	18:19:11	19:19:24	85' to 120' port	29°12.703 N	89°17.163 W	3933950.6	264666.8	pipe / debris
A22	2	53%	17	16-Feb-00	18:30:44	18:30:49	85' to 125' port	29°12.720 N	89°17.166 W	3933932.9	264769.6	long narrow object w/ scattered objects
A23	2	53%	17	16-Feb-00	18:31:46	18:31:51	57' port	29°12.715 N	89°17.047 W	3934566	264750.6	scattered debris
A24	2	55%	20	17-Feb-00	13:47:25	13:47:32	53' to 90' port	29°12.752 N	89°17.253 W	3933466.9	264955.2	scattered debris
A25	2	55%	21	17-Feb-00	13:53:08	13:53:14	123' to 150' port	29°12.753 N	89°17.154 W	3933993.1	264970.7	large ferrous object

Table 6. Target Table for Blocks 1 and 2 of West Bay Diversion Project

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
Target #1											
M36	1	6	2/15/00	16:26:01	16:25:32	28.5	D	0:00:29	3932978.5	267277.8	localized debris
M37	1	7	2/15/00	16:37:24	16:36:55	22.5	D	0:00:29	3932985.5	267251.1	
Target #2											
M35	1	6	2/15/00	16:23:25	16:22:47	32	D	0:00:38	3933699.7	266122.0	area of scattered
M38	1	7	2/15/00	16:39:52	16:39:17	28	D	0:00:35	3933608.0	266102.6	debris
M46	1	8	2/15/00	17:51:29	17:50:47	15.5	MC	0:00:42	3933540.5	266148.6	
M58	1	10	2/16/00	13:32:30	13:31:37	18.5	-	0:00:53	3933419.3	266147.9	
Target #3											
M1	1	1	2/15/00	11:06:08	11:05:29	12.5	D	0:00:39	3933997.1	266050.2	area of scattered
M16	1	3	2/15/00	13:43:57	13:43:33	15.5	-	0:00:24	3933905.9	266010.6	debris
M22	1	4	2/15/00	14:54:52	14:54:29	24	-	0:00:23	3933868.5	266013.0	
Target #4											
M39	1	7	2/15/00	16:43:08	16:41:53	20	MC	0:01:15	3934475.2	264585.9	debris
M47	1	8	2/15/00	17:48:06	17:47:19	17.5	MC	0:00:47	3934412.3	264643.3	
M104	2	14	2/16/00	17:12:51.5	17:13:07.4	10	+	0:00:16	3934496.7	264600.6	
Target #5											
M68	1	12	2/16/00	14:56:33	14:55:51	115	+	0:00:42	3934026.4	264837.1	area of scattered
A17	1	12	2/16/00	15:55:07	15:55:27				3934021.3	264880.3	debris
Target #6											
M109	2	16	2/16/00	17:26:46.4	17:27:16.5	50	D	0:00:30	3933432.0	264748.7	area of scattered
M112	2	17	2/16/00	17:30:49.3	17:31:06.3	240	D	0:00:17	3933448.8	264809.2	debris
M114	2	18	2/17/00	12:35:45.5	12:36:14.6	90	D	0:00:29	3933454.4	264835.5	

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
Target #7											
M116	2	19	2/17/00	12:45:04.4	12:45:20.2	90	-	0:00:16	3932731.6	264948.4	area of scattered
M117	2	20	2/17/00	12:46:43.5	12:47:17.4	210	+	0:00:34	3932716.8	265014.5	debris
M120	2	21	2/17/00	12:57:00.2	12:57:11.7	160	+	0:00:12	3932697.9	265038.7	
Target #8											
M102	2	12	2/16/00	17:02:26.4	17:02:37.3	230	+	0:00:11	3932909.4	264593.9	associated with
M103	2	13	2/16/00	13:10:52.4	13:11:02.3	50	+	0:00:10	3932913.8	264624.3	possible modern
M106	2	14	2/16/00	17:16:29.7	17:16:40.7	20	D	0:00:11	3932925.9	264702.6	wreck (NOAA
M110	2	16	2/16/00	17:27:58.8	17:28:07.6	25	D	0:00:09	3932919.7	264770.4	chart #11361)
Target #9											
M74	2	2	2/16/00	15:40:39.9	15:40:48.1	30	MC	0:00:08	3933069.6	264088.8	area of scattered
M79	2	3	2/16/00	15:51:08.9	15:51:16.0	60	-	0:00:07	3933056.9	264141.9	debris
M85	2	5	2/16/00	16:01:17.3	16:01:27.1	25	+	0:00:10	3933163.1	264216.5	
M86	2	5	2/16/00	16:01:31.0	16:01:34.9	90	+	0:00:04	3933056.4	264215.3	
M87	2	6	2/16/00	16:11:24.2	16:11:31.3	45	+	0:00:07	3933035.6	264286.6	
M88	2	6	2/16/00	16:11:35.1	16:11:45.0	70	D	0:00:10	3933110.0	264263.6	
M90	2	7	2/16/00	16:21:20.1	16:21:35.3	70	MC	0:00:15	3933088.9	264316.2	
Target #10											
M78	2	3	2/16/00	15:49:13.3	15:49:47.3	30	MC	0:00:34	3933891.7	264090.1	area of scattered
M82	2	4	2/16/00	15:53:46.2	15:53:58.8	80	+	0:00:13	3933858.5	264119.4	debris
M84	2	5	2/16/00	15:59:55.1	16:00:08.9	150	+	0:00:14	3933829.5	264167.8	
M89	2	6	2/16/00	16:12:52.9	16:13:14.3	20	-	0:00:21	3933838.3	264252.4	
Target #11											
M34	1	6	2/15/00	16:17:14	16:16:43	27.5	D	0:00:31	3935173.6	263453.1	long linear
A5	1	8	2/15/00	18:43:16	18:43:39				3935139.1	263336.3	area associated
A11	1	10	2/16/00	14:23:51	14:23:51				3935136.6	263178.6	with dredging
A16	1	12	2/16/00	15:51:08	15:51:08				3935053.1	263092.3	

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
Target #12											
M17	1	3	2/15/00	13:51:02	13:49:59	67.5	D	0:01:03	3935821.1	262619.4	localized debris
M23	1	4	2/15/00	14:47:43	14:46:53	41	D	0:00:50	3935781.1	262617.7	
Target #13											
M40	1	7	2/15/00	16:48:46	16:47:26	22.5	D	0:01:20	3935924.7	262061.2	localized debris
M48	1	8	2/15/00	17:42:26	17:39:39	37.5	D	0:02:47	3935873.2	262068.3	
Target #14											
M18	1	3	2/15/00	13:53:45	13:52:23	33.5	-	0:01:22	3936772.7	261034.3	area of scattered
M24	1	4	2/15/00	14:44:15	14:43:25	128.5	D	0:00:50	3936771.8	260945.6	debris
M26	1	5	2/15/00	15:23:20	15:22:37	184	D	0:00:43	3936746.8	260878.4	
M33	1	6	2/15/00	16:11:25	16:10:08	121	D	0:01:17	3936700.3	260887.9	
M41	1	7	2/15/00	16:51:47	16:50:13	52	D	0:01:34	3936669.9	260859.0	
Target #15											
M50	1	8	2/15/00	17:35:08	17:34:44	10.5	+	0:00:24	3937571.0	259242.6	area of scattered
M54	1	9	2/16/00	12:30:51	12:30:30	37	-	0:00:21	3937584.8	259101.6	debris
M60	1	10	2/16/00	13:14:47	13:14:22	27	-	0:00:25	3937540.7	259105.7	
M64	1	11	2/16/00	14:01:30	14:01:02	27.5	+	0:00:27	3937506.6	259021.4	
Target #16											
A6	1	9	2/16/00	13:31:34	13:31:39				3938178.9	258141.3	catchment area
A8	1	10	2/16/00	14:10:41	14:10:41				3938152.7	258116.6	created by dredging
Target #17											
M65	1	11	2/16/00	14:03:54	14:03:28	26	D	0:00:27	3938205.8	257922.5	long linear area
A7	1	10	2/16/00	14:10:08	14:10:08				3938284.0	257912.8	associated with dredging

Anom#	Block #	Line	Date	Event Time	Event Time	Gamma	Signature	Duration (sec)	X	Y	Comments
Target #18											
M5	1	1	2/15/00	11:27:58	11:27:12	20	D	0:00:46	3939612.4	256503.6	localized debris
M9	1	2	2/15/00	12:05:09	12:04:36	20.5	D	0:00:33	3939612.1	256481.6	
Target #19											
M61	1	10	2/16/00	13:07:16	13:06:04	32	MC	0:01:12	3939291.6	256212.5	area of scattered
M66	1	11	2/16/00	14:08:31	14:06:59	54	MC	0:01:32	3939259.2	256138.7	debris
M69	1	12	2/16/00	14:36:06	14:34:49	23	D	0:01:17	3939224.4	256173.5	
A15	1	11	2/16/00	15:06:22	15:06:30				3939285.1	256081.9	
Target #20											
M32	1	6	2/15/00	15:58:58	15:58:31	21	D	0:00:27	3939858.4	255454.4	area of scattered
M44	1	7	2/15/00	17:03:07	17:02:48	17	-	0:00:19	3939790.8	255499.4	debris
Target #21											
M20	1	3	2/15/00	14:12:38	14:12:10	36	MC	0:00:28	3941530.2	251741.6	area of scattered
M25	1	4	2/15/00	14:24:39	14:24:15	46.5	D	0:00:24	3941471.3	251735.9	debris
M28	1	5	2/15/00	15:43:34	15:42:42	20.5	MC	0:00:52	3941422.3	251742.5	
Target #22											
M92	2	8	2/15/00	16:39:06.2	16:39:22.2	20	+	0:00:16	3932991.3	264401.4	associated with
M93	2	9	2/15/00	16:40:02.1	16:40:07.0	65	+	0:00:05	3932792.6	264427.7	possible modern
M122	2	*PL	2/17/00	14:01:13.8	14:01:18.7	60	-	0:00:05	3932747.7	264425.8	wreck (NOAA
M123	2	*PL	2/17/00	14:02:52.5	14:03:00.7	35	D	0:00:08	3932856.7	264385.5	chart #11361)
M125	2	*PL	2/17/00	14:10:21.5	14:10:27.6	35	+	0:00:06	3933036.8	264400.7	
M126	2	*PL	2/17/00	14:05:14.8	14:05:17.6	25	+	0:00:03	3932749.4	264431.9	
M127	2	*PL	2/17/00	14:06:58.8	14:07:05.5	110	D	0:00:07	3932930.9	264380.6	

Areas of Scattered Debris

Target #2. This target is located in the north-central area of the Anchorage Project Area and remote sensing survey area (Block 1). Target #2 consists of four magnetic anomalies (M35, M38, M46, and M58) (Figure 22). Two anomalies, M35 and M38, are dipolar with low amplitudes of 32 and 28 gammas, respectively. These two anomalies also have long durations of 38 and 35 seconds, respectively. M46 is a multi-component anomaly with low amplitude of 15.5 gammas and a long duration of 42 seconds. M58 is monopole with low amplitude of 18.5 gammas and a long duration of 53 seconds. There are no acoustic data that correlate with Target #2. This target's signatures are indicative of modern ferrous debris and do not indicate shipwreck or other potentially significant cultural resources. Therefore, no further study of Target #2 is recommended or warranted.

Target #3. This target is located on the northeastern section of the Anchorage Project Area and the remote sensing survey (Block 1). Three magnetic targets (M1, M16, and M22) encompass Target #3. M1 is a dipolar anomaly with a low amplitude of 12.5 gammas and a long duration of 39 seconds. Both M16 and M22 are monopolar disturbances with low amplitudes. M16 exhibits 15.5 gammas and a medium duration of 24 seconds. M22 exhibits 24 gammas, with a medium duration of 23 seconds. There are no acoustical data related to this target. The signatures of these anomalies are not typical of a shipwreck or other culturally significant resources. They are indicative of modern ferrous debris. Therefore, no further study of Target #3 is recommended or warranted.

Target #4. This target is located in the north-central section of the Anchorage Project Area and the remote sensing survey (Block 1). Target #4 is comprised of 3 magnetic anomalies (M39, M47, and M104) (Figure 23). M39 and M47 both have multi-component signatures with low amplitudes and long duration. M39 has a low amplitude of 20 gammas with a 75 second duration. M47 also has a low amplitude of 17.5 gammas, with a 47 second duration. M104 is a monopolar anomaly of low amplitude (10 gammas) and medium duration (16 seconds). No acoustic data were detected for this target. These signatures are representative of a scatter of ferrous debris that probably is modern. These signatures are not typical of significant cultural resources or a shipwreck. No further study of this target is recommended or warranted.

Target #5. This target is located along the eastern edge of the Cut/Diversion Project Area of the survey (Block 2 of remote sensing survey), as well as the western edge of the Anchorage Area (Block 1 of the remote sensing survey). One magnetic anomaly (M68) and one acoustic anomaly (A17) comprise Target #5. M68 has a medium-to-long duration of 42 seconds, and high amplitude of 115 gammas; it is a positive monopole. A17 represents an area of scattered debris along the bottom of the river. These signatures are not indicative of significant cultural resources or a shipwreck. Therefore, no further study of this target is recommended or warranted.

Target #6. Target #6 consists of three magnetic anomalies (M109, M112, and M114). It is located in the center of the Cut/Diversion Project Area of the survey (Block 2 of the remote sensing survey). All three anomalies have dipolar signatures of medium-to-high amplitude and medium duration. M109 exhibits 50 gammas and a duration of 30 seconds; M112 exhibits 240 gammas with a 17 second duration; and, M114 exhibits 90 gammas and a 29 second duration. No acoustic anomalies were detected that correlate with the magnetic data at this target. This target likely represents an area of scattered debris. The signatures of this target are not indicative of significant cultural resources or a shipwreck. Therefore, no further study of this target is recommended or warranted.

Target #7. This target is located along the northwestern edge of the Cut/Diversion Project Area (Block 2 of the remote sensing survey), and possibly represents modern ferrous bank debris. Three magnetic anomalies (M116, M117, and M120) comprise Target #7. M116 has a medium duration of 16 seconds with high amplitude of 90 gammas, and a negative monopolar signature. M117 has a medium-

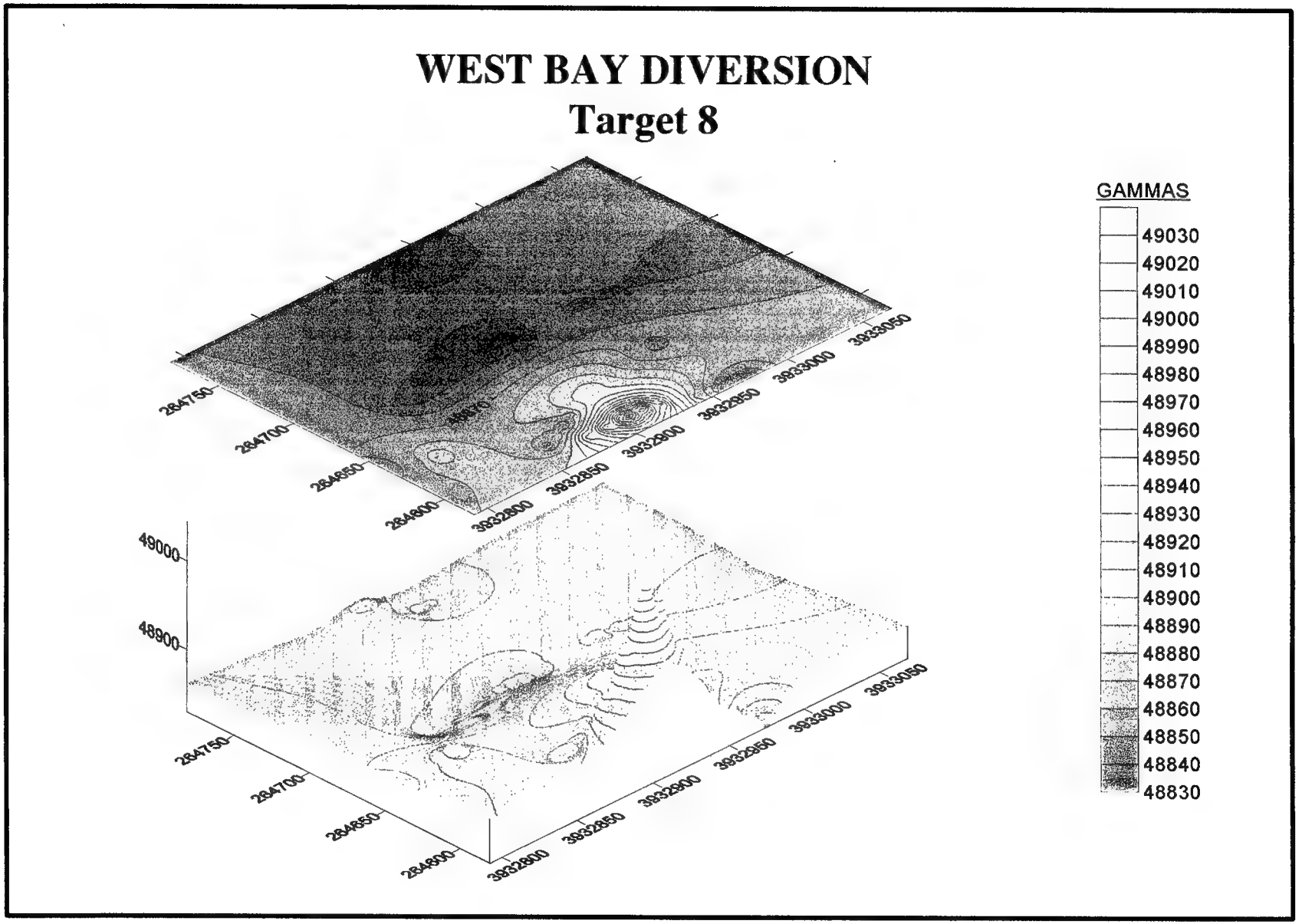


Figure 13. Magnetic contouring of Target 8.

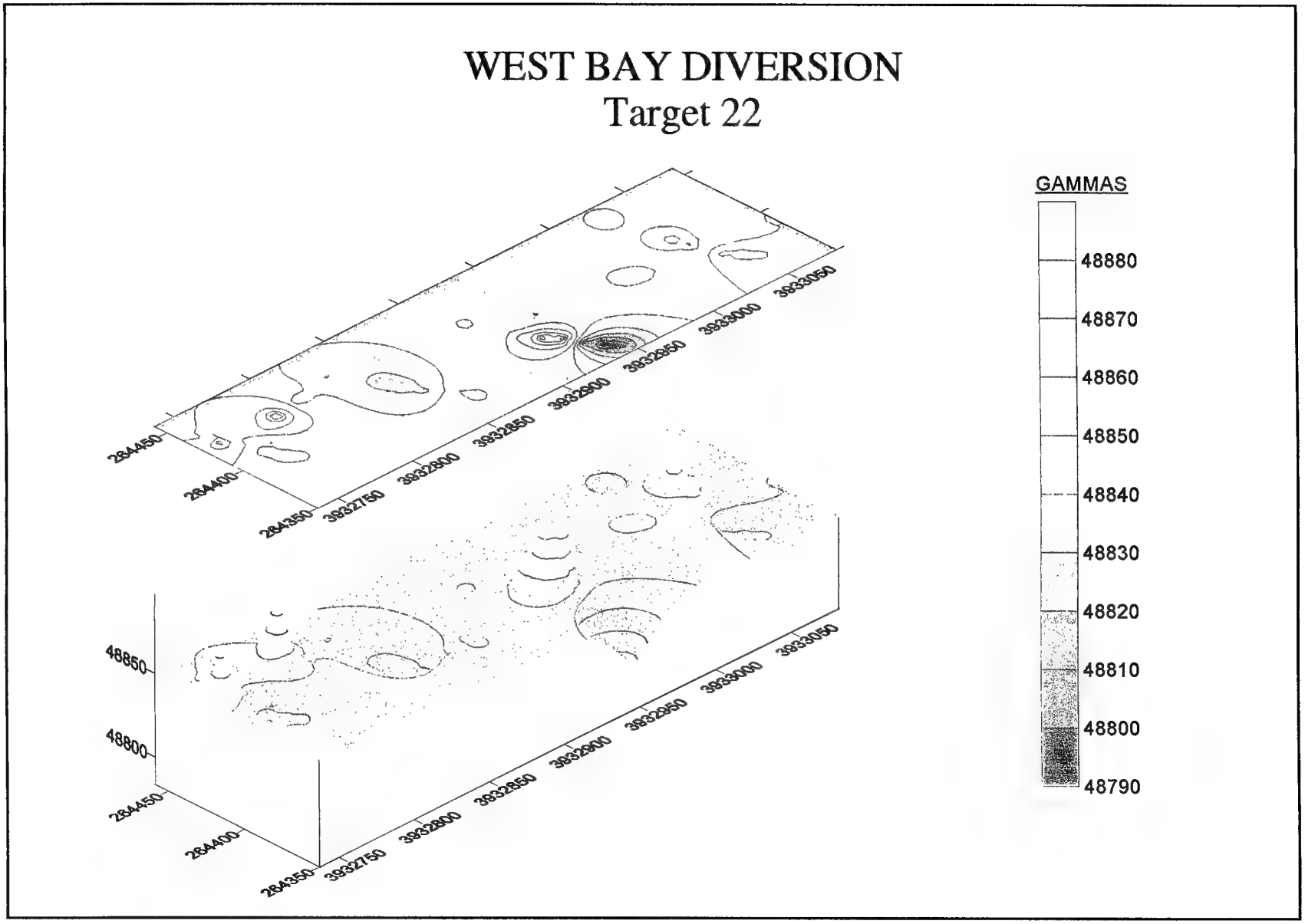


Figure 14. Magnetic contouring of Target 22.

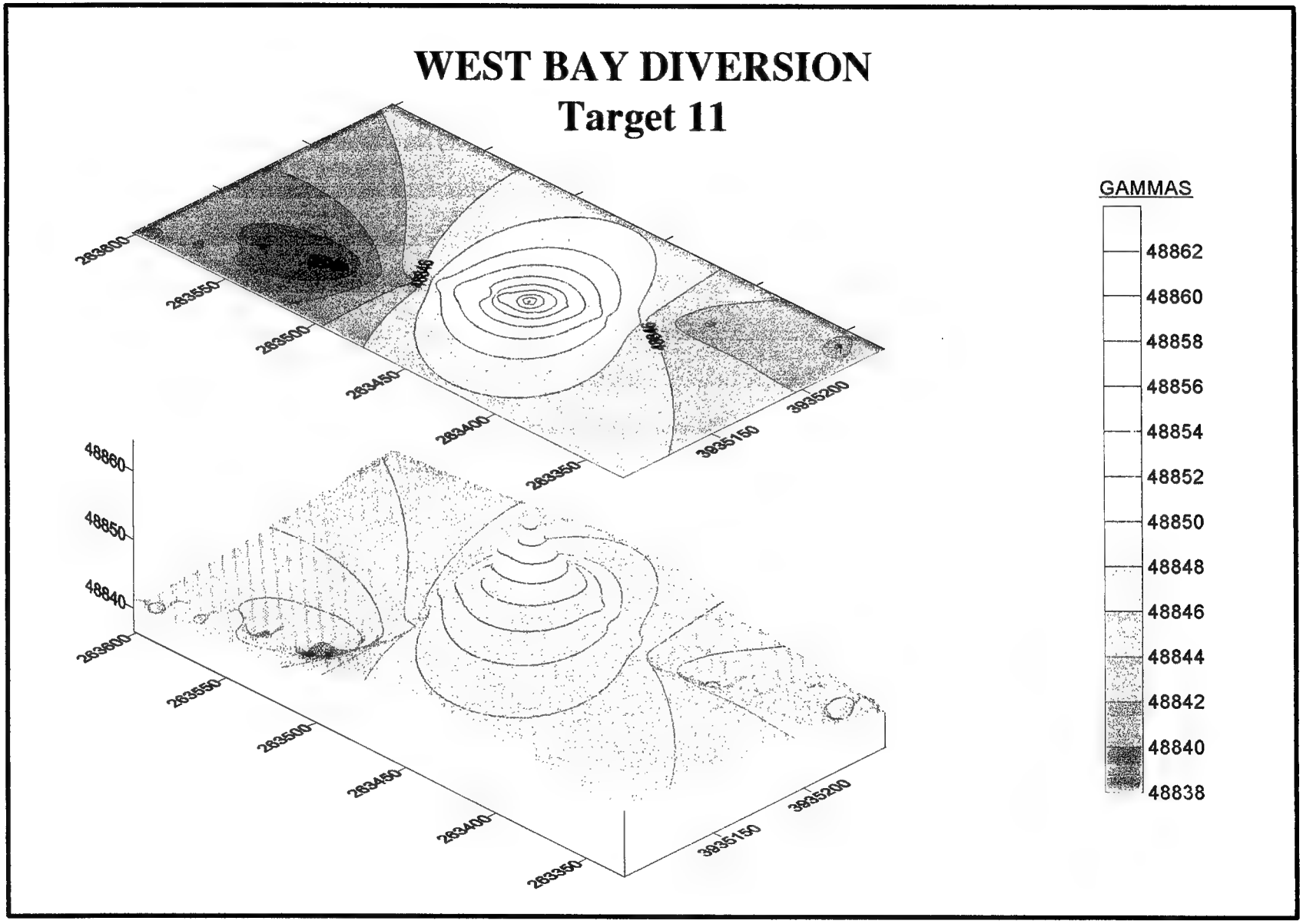


Figure 15. Magnetic contouring of Target 11.

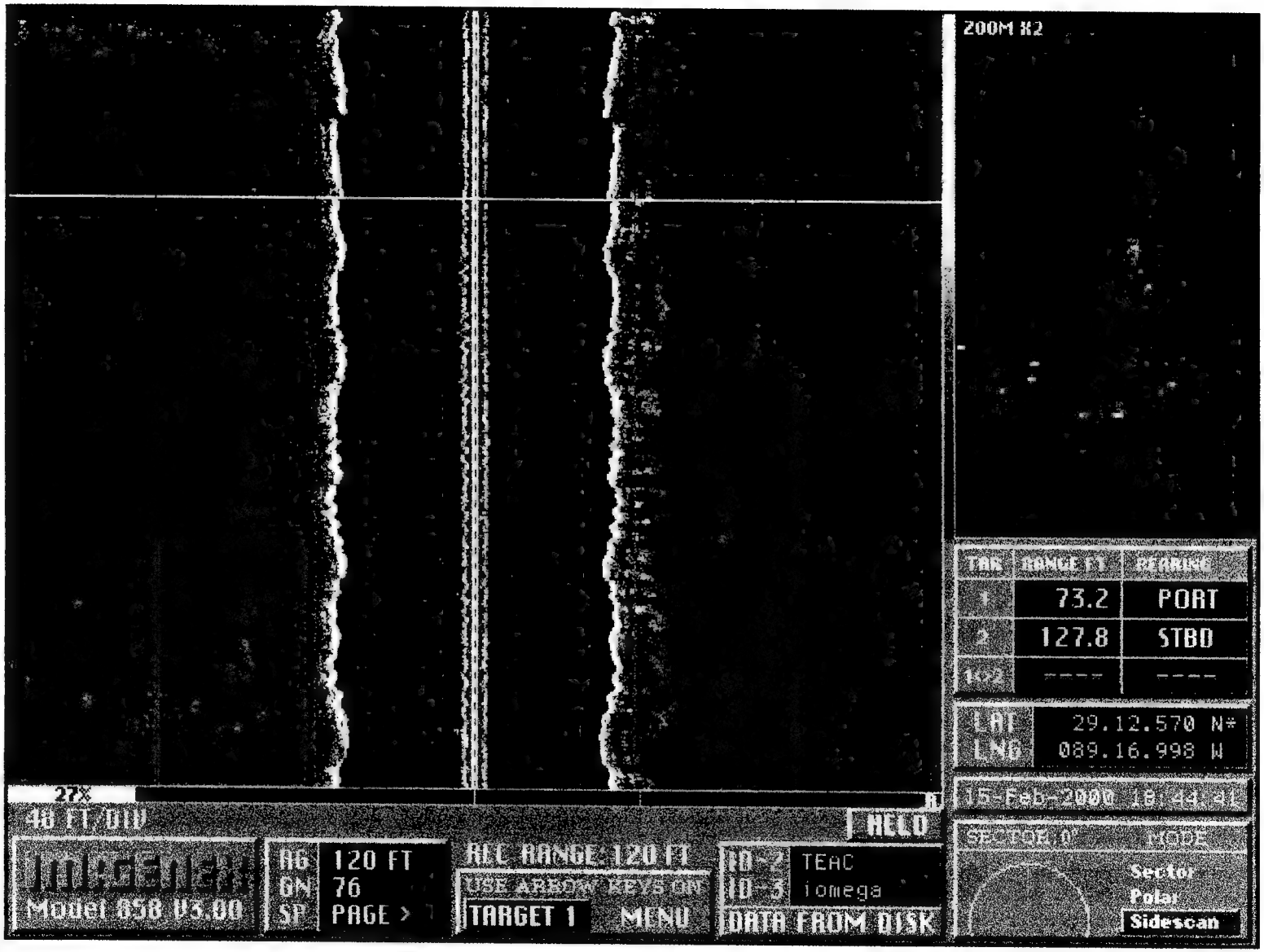


Figure 16. Imagenex 858 side scan sonar image of the possible source of magnetic pertubations associated with Target 11, acoustic 5, linear area associated with dredging.

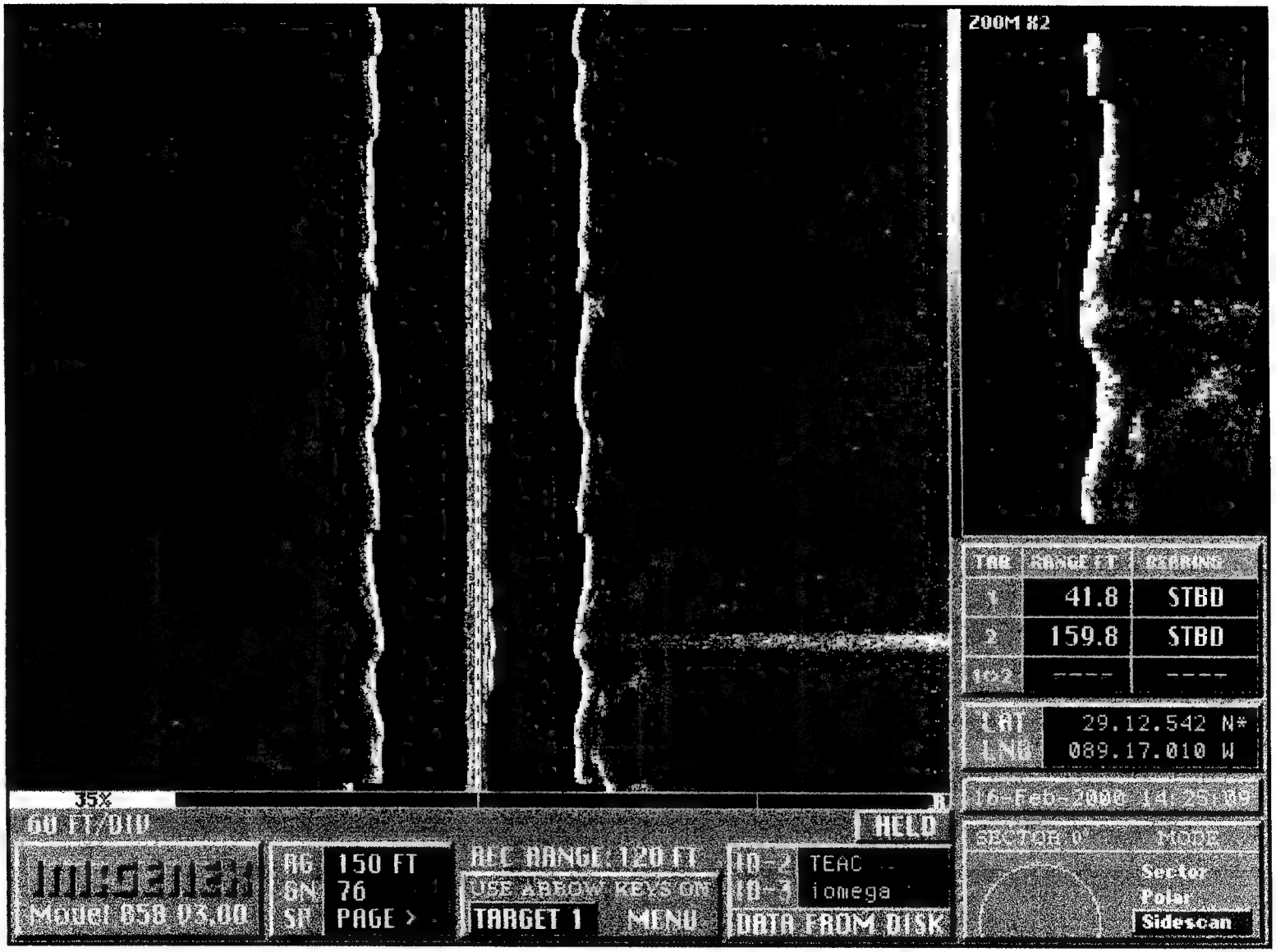


Figure 17. Imagenex 858 side scan sonar image of the possible source of magnetic pertubations associated with target 11 acoustic 11, linear area associated with dredging.

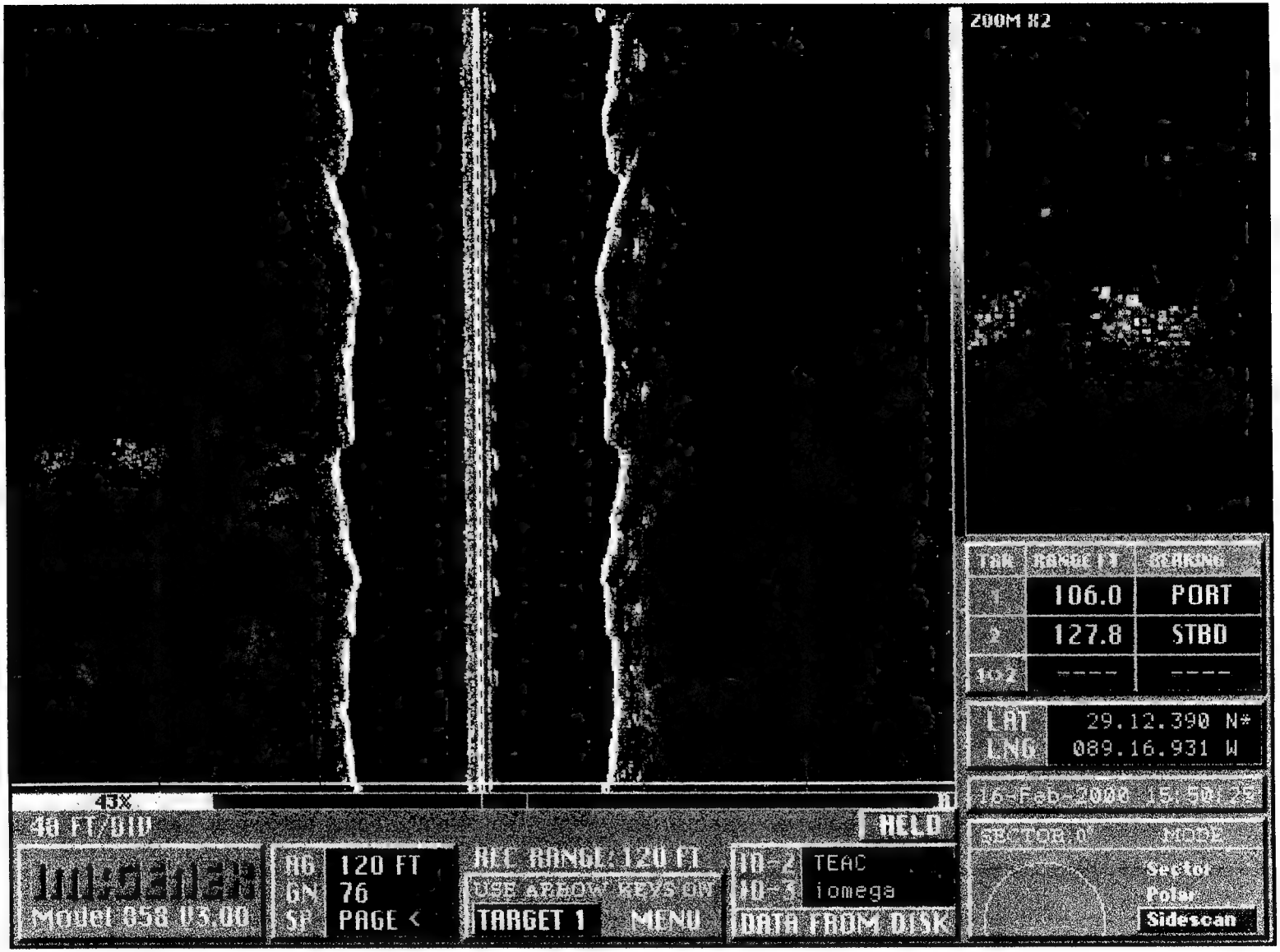


Figure 18. Imagenex 858 side scan sonar image of the possible source of magnetic pertubations assoiciated with Target 11, acoustic 16, linear area associated with dredging.

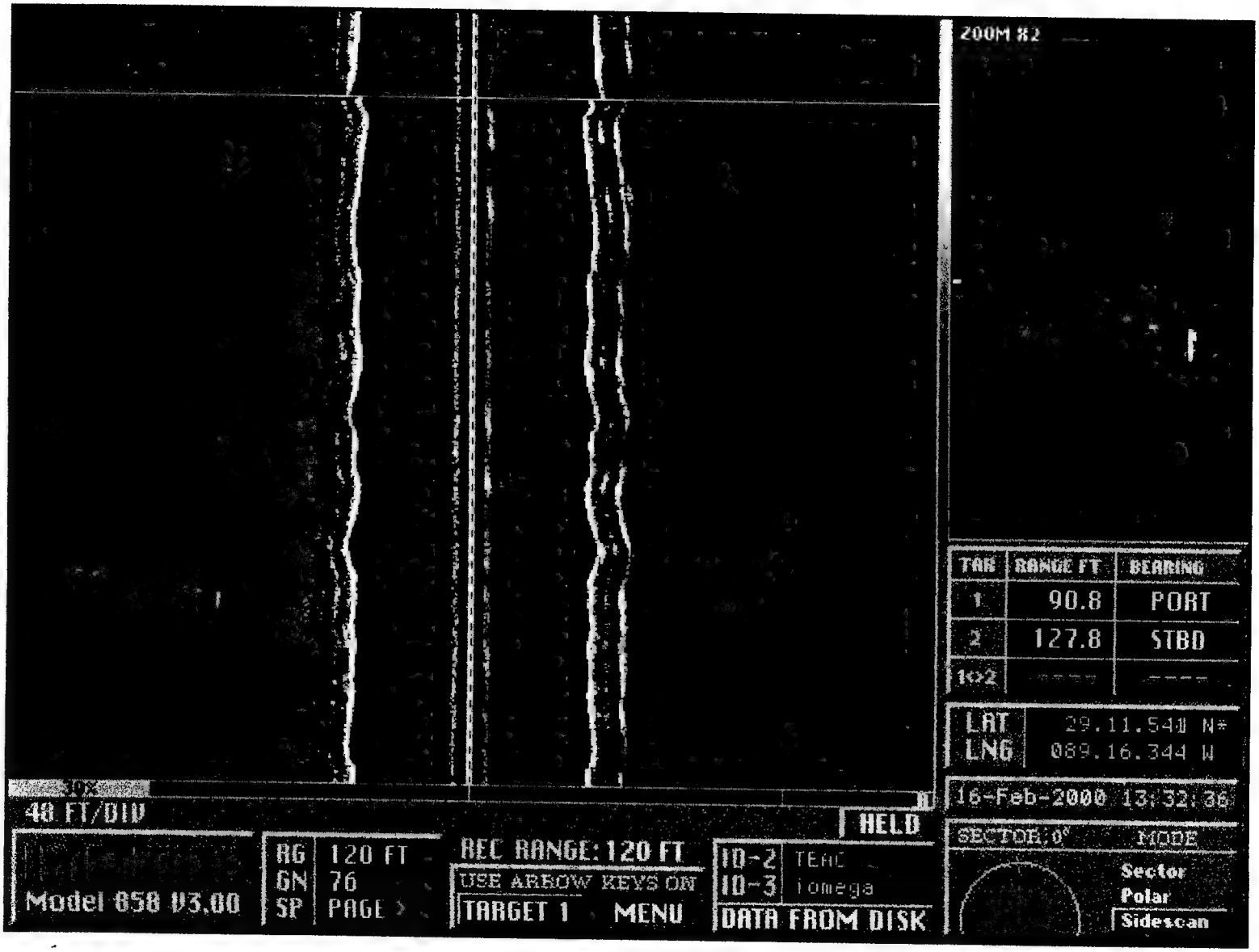


Figure 19. Imagenex 858 side scan sonar image associated with Target 16, acoustic 6, catchment area created by dredging.

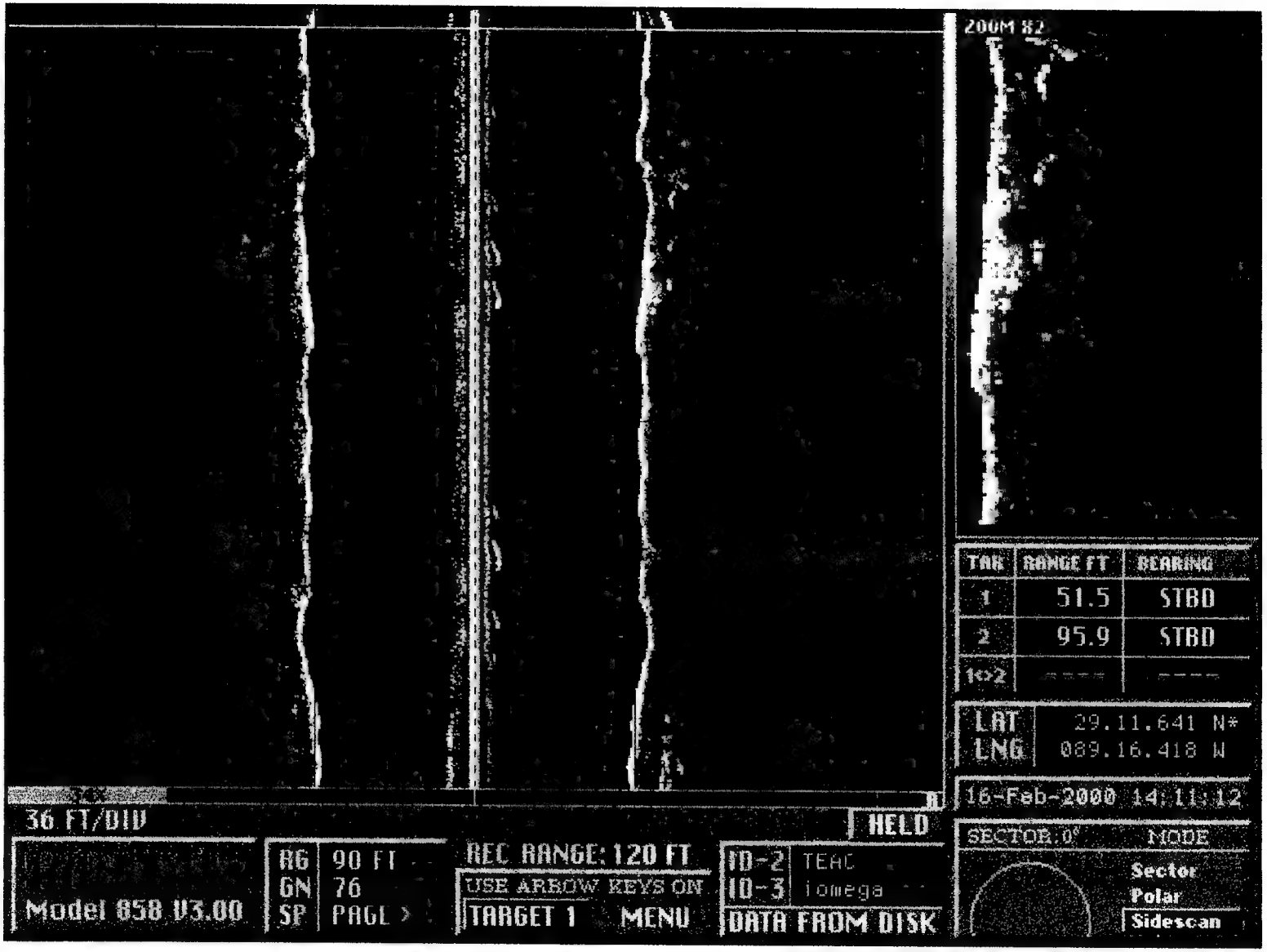


Figure 20. Imagenex 858 side scan sonar image associated with Target 16, acoustic 8, catchment area created by dredging.

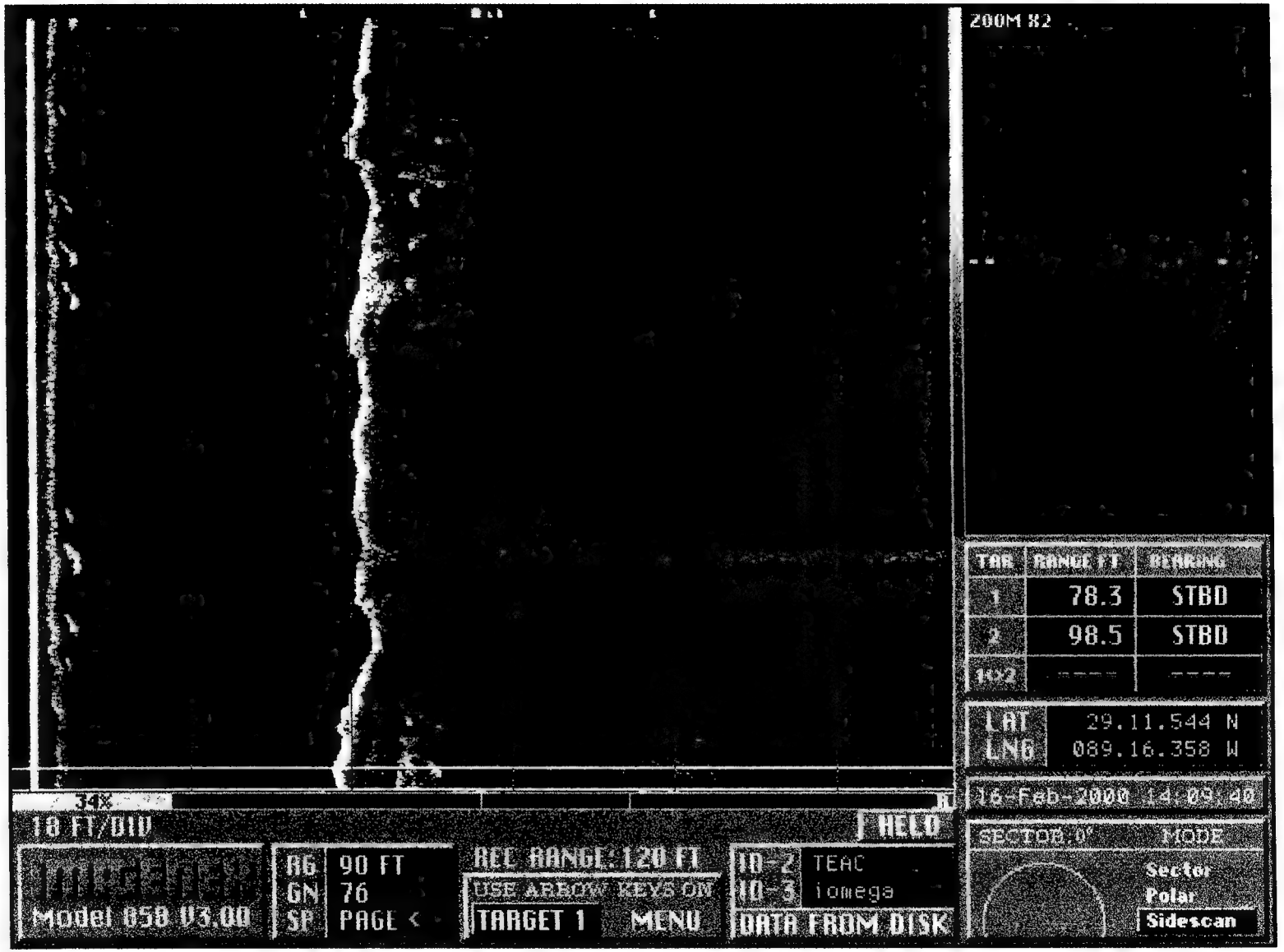


Figure 21. Imagenex 858 side scan sonar image associated with Target 17, acoustic 7, long linear area associated with dredging.

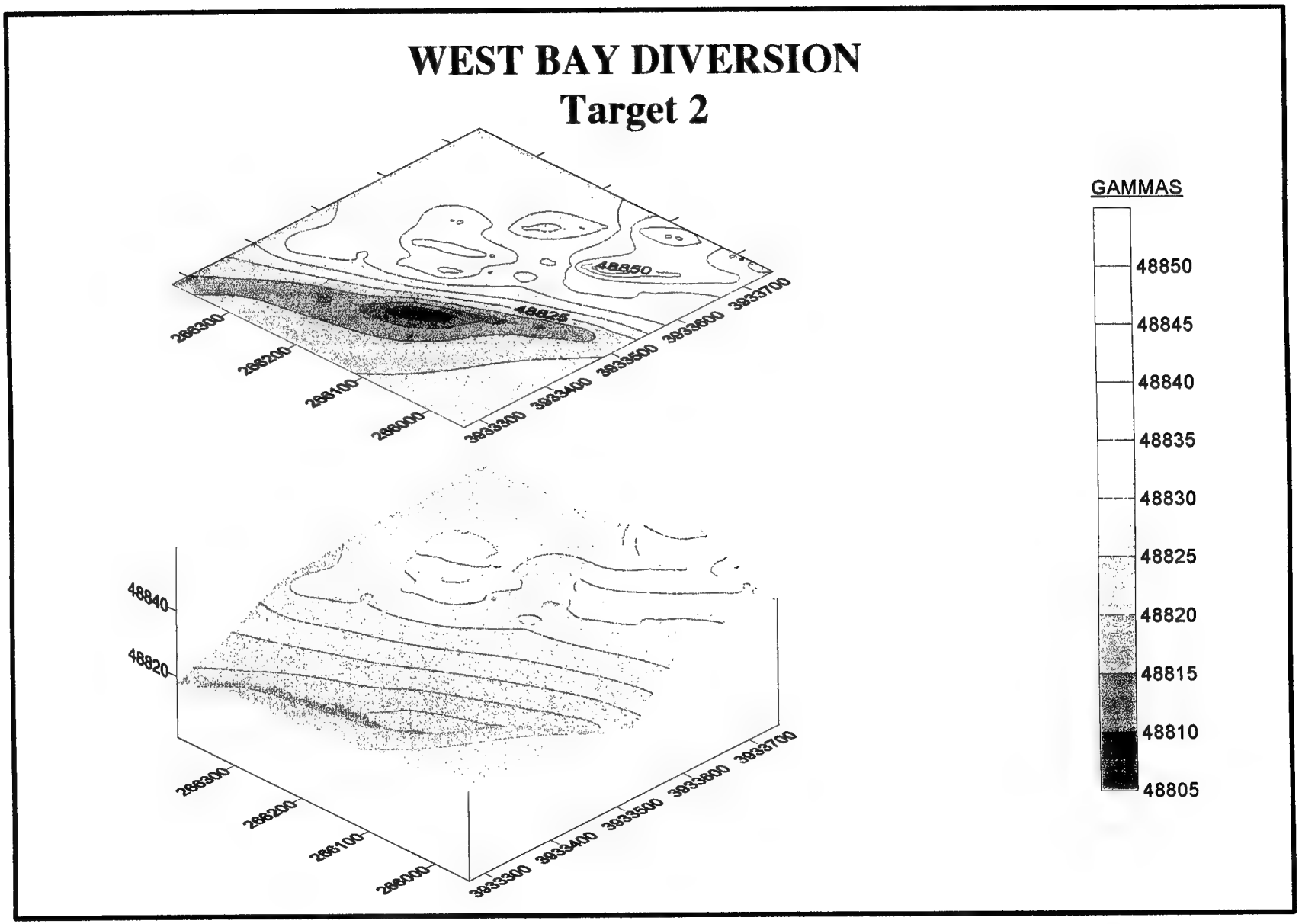


Figure 22. Magnetic contouring of Target 2.

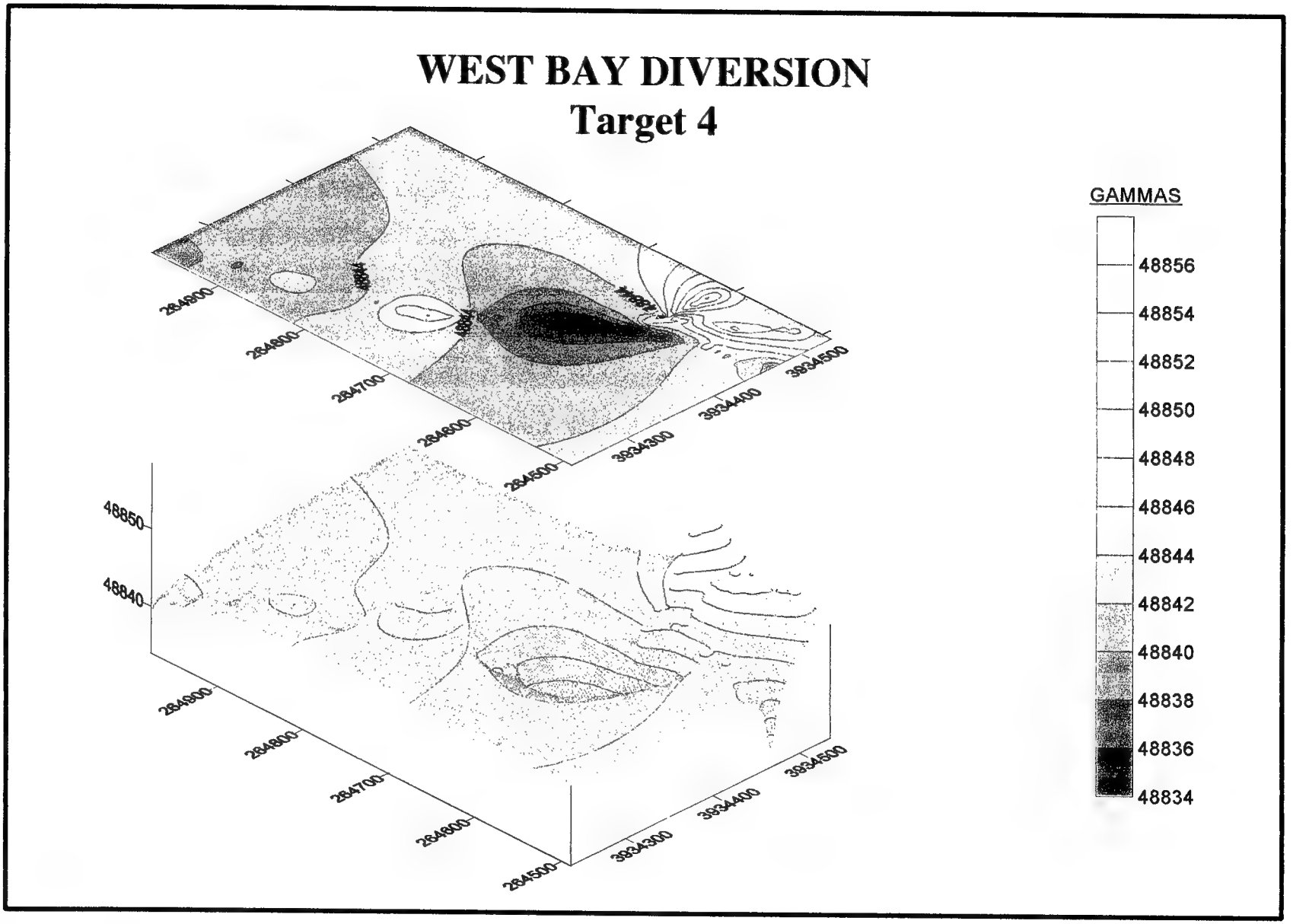


Figure 23. Magnetic contouring of Target 4.

to-long duration of 34 seconds with high amplitude of 240 gammas; it is a positive monopole. M120 has a short duration of 12 seconds with a high amplitude of 160 gammas; it is a positive monopole. The signatures defined in this target area are not consistent with significant cultural resources or a shipwreck. No further study of this target is recommended or warranted.

Target #9. Seven magnetic anomalies (M74, M79, M85, M86, M87, M88, and M90) comprise Target #9 (Figure 24). This target is located at the southwestern end of the Cut/Diversion Project Area (Block 2 of the remote sensing survey). Only two of these anomalies (M74 and M90) are multi-component disturbances; M74 has a short duration of 8 seconds, and a low amplitude of 30 gammas, M90 has a short duration of 15 seconds and medium amplitude of 70 gammas. M88 has a dipolar signature with a short duration of 10 seconds and a medium amplitude of 70 gammas. The other anomalies within this target all are monopolar with short durations and that range in amplitude from 25 to 90 gammas. This target has no acoustic anomalies, and likely represents an area of scattered modern debris. The signatures of this target are not indicative of significant cultural resources or a shipwreck. No further study of the target is recommended or warranted.

Target #10. This target is located at the southeastern edge of the Cut/Diversion Area (Block 2 of the remote sensing survey). It consists of four magnetic anomalies (M78, M82, M84, and M89) (Figure 25). M78 is the only anomaly that is a multi-component; the other anomalies all are monopolar. M78 has a medium duration of 34 seconds and low amplitude of 30 gammas. M82 has a short duration of 13 seconds, with a high amplitude of 80 gammas. M84 has a medium duration of 14 seconds and a high amplitude of 150 gammas. M89 has a medium duration of 21 seconds, with a low amplitude of 20 gammas. No acoustic data were identified for this target, which appears to comprise an area of modern scattered bank debris buried under marine sediment. The signatures observed during the survey for this target are not consistent with significant cultural resources or a shipwreck. No further study of this target is recommended or warranted.

Target #14. Target #14 comprises five magnetic anomalies (M18, M24, M26, M33, and M41). The target is located in the center of the Anchorage Area (Block 1 of the remote sensing survey). Four of the anomalies are dipoles (M24, M26, M33, and M41), while one is a negative monopole (M18). M18 has a duration of 82 second with medium amplitude of 33.5 gammas; M24 has a duration of 50 seconds with high amplitude of 128.5 gammas; M26 has a duration of 43 seconds with high amplitude of 184 gammas; M33 has a duration of 77 seconds with high amplitude of 121 gammas; and, M41 has a duration of 94 seconds with medium amplitude of 52 gammas. No acoustic anomalies were associated with this target. The signatures of the anomalies within the target are indicative of scattered modern ferrous debris; they are not consistent with significant cultural resources or a shipwreck. No further study of this target is recommended or warranted.

Target #15. Target #15 is located on the western edge of the Anchorage Area (Block 1 of the remote sensing survey). Four magnetic anomalies (M50, M54, M60, and M64) constitute this target. The low amplitudes of the anomalies indicate that this target likely represents an area of scattered ferrous debris. M50 has a medium duration of 24 seconds with an amplitude of 10.5 gammas; M54 has a medium duration of 21 seconds with 37 gammas; M60 has a medium duration of 25 seconds with 27 gammas; and, M64 has a medium duration of 27 seconds with 27.5 gammas. No acoustic disturbances were detected for this target. These signatures are not indicative of significant cultural resources or a shipwreck. No further study of Target #15 is recommended or warranted.

Target #19. The eastern edge of the anchorage area (Block 1 of the remote sensing survey) is the site of Target #19. Three magnetic anomalies (M61, M66, and M69) and one acoustic anomaly (A15) define this target. Two of the magnetic anomalies, M61 and M66, are multi-component disturbances; M69 is dipolar. M61 has a low amplitude of 32 gammas with a long duration of 72 seconds. M66 has

medium amplitude of 54 gammas with a long duration of 92 seconds. M69 has low amplitude of 23 gammas with a long duration of 77 seconds (Figure 26). A15 is the associated acoustic anomaly for this target (Figure 27). The data are indicative of scattered, presumably modern, ferrous debris. Target #19 is not similar in signature to significant submerged cultural resources or a shipwreck. No further study of this target is recommended.

Target #20. Target #20 is located at the southern end of the survey area in the center of the Anchorage Area (Block 1 of the remote sensing survey). M32 and M44 are the two magnetic anomalies that make up this target. M32 is dipolar with a medium duration of 27 seconds and low amplitude of 21 gammas. M44 is a negative monopole of low amplitude, 17 gammas, and a medium duration of 19 seconds. No acoustic data were associated with this target. This most likely is a scattered area of modern ferrous debris. No further study is recommended or warranted.

Target #21. Target #21 is situated on the southwestern side of the Anchorage Area (Block 1 of remote sensing survey area) (Figure 28). Two multi-component magnetic anomalies (M20 and M28) and one dipolar anomaly (M25) make up this target. M20 has a medium duration of 28 seconds and a low amplitude of 36 gammas. M25 has a medium duration of 24 seconds and a low amplitude of 46.5 seconds. M28 has a long duration of 52 seconds with a low amplitude of 20.5 gammas. No acoustic anomalies were associated with Target #21. These signatures do not illustrate a culturally significant resource or shipwreck. No further study is recommended or warranted.

Localized Debris

Target #1. Two magnetic disturbances (M36 and M37) comprise Target #1. Both are considered to be low amplitude at 28.5 and 22.5 gammas, respectively. M36 and M27 have a low to medium duration of 29 seconds, and show dipole signatures. No acoustical anomalies were associated with this target. These data suggest that Target #1 represents an area of scattered, presumably modern, ferrous debris. The magnetic attributes of the anomalies comprising this target are not typical of a shipwreck or other potentially significant cultural resource. No further study of Target #1 is recommended or warranted.

Target #12. Two magnetic anomalies (M17 and M23) comprise Target #12, which is in mid-channel of Block 1. Both are dipolar and are considered to have long duration. M17 has medium amplitude of 67.5 gammas and a duration of 63 seconds. M23 has low amplitude of 41 gammas and a duration of 50 seconds. No acoustic data were associated with this target. Target #12 is consistent with and is believed to be localized debris. This target is not indicative of a submerged cultural resource. No further work is recommended.

Target #13. Target #13 is in mid-channel of Block 1; it is defined by two magnetic anomalies (M40 and M48). Both disturbances are dipolar with low amplitudes and long durations. M40 is 22.5 gammas in amplitude with a duration of 80 seconds; M48 is 37.5 gammas in amplitude with a duration of 167 seconds. No acoustic data were related to this target. The information is indicative of localized ferrous debris. Target #13 does not appear to represent a submerged cultural resource. No further study is recommended or warranted.

Target #18. Target # 18 is on the eastern edge of Block 1 of the remote sensing survey in the Anchorage Area. It comprises two magnetic disturbances (M5 and M9). M5 is a dipolar anomaly with low amplitude of 20 gammas and a long duration of 46 seconds. M9 is also dipolar, with a low amplitude of 20.5 gammas and a long duration of 33 seconds. There were no acoustic anomalies associated with this target. This also appears to be an area of localized ferrous debris, and not a submerged cultural resource. No further study of Target #18 is recommended.

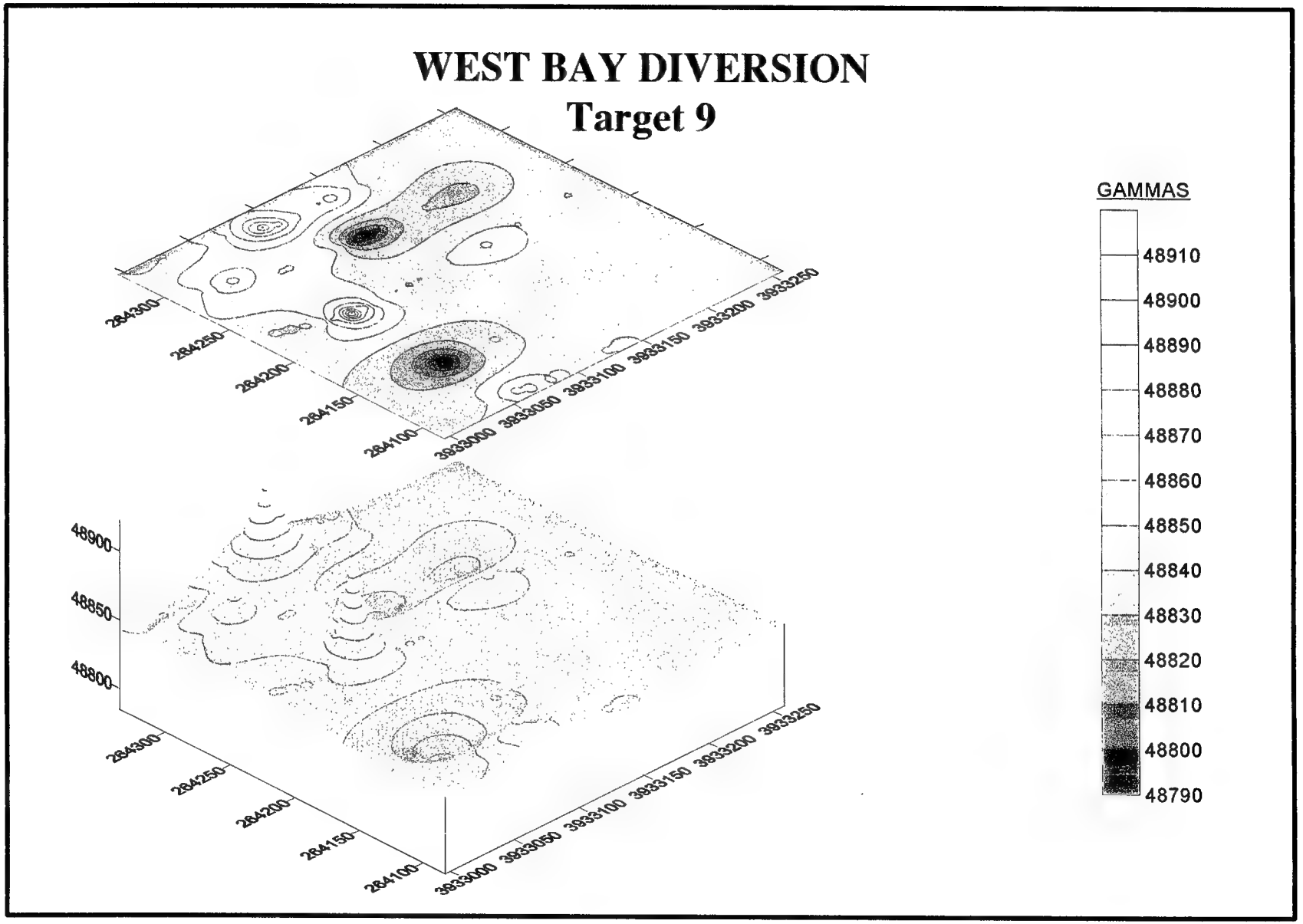


Figure 24. Magnetic contouring of Target 9.

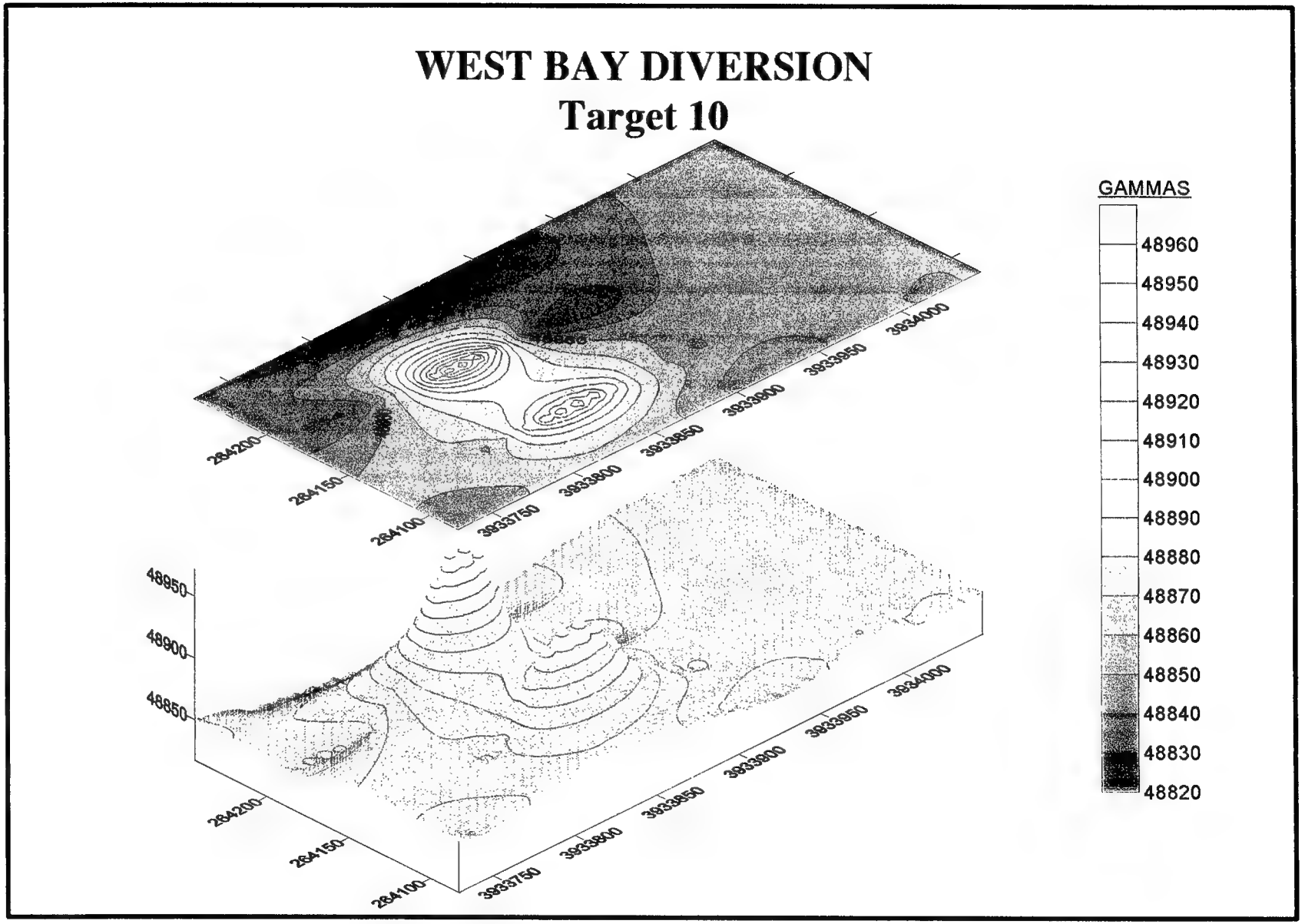


Figure 25. Magnetic contouring of Target 10.

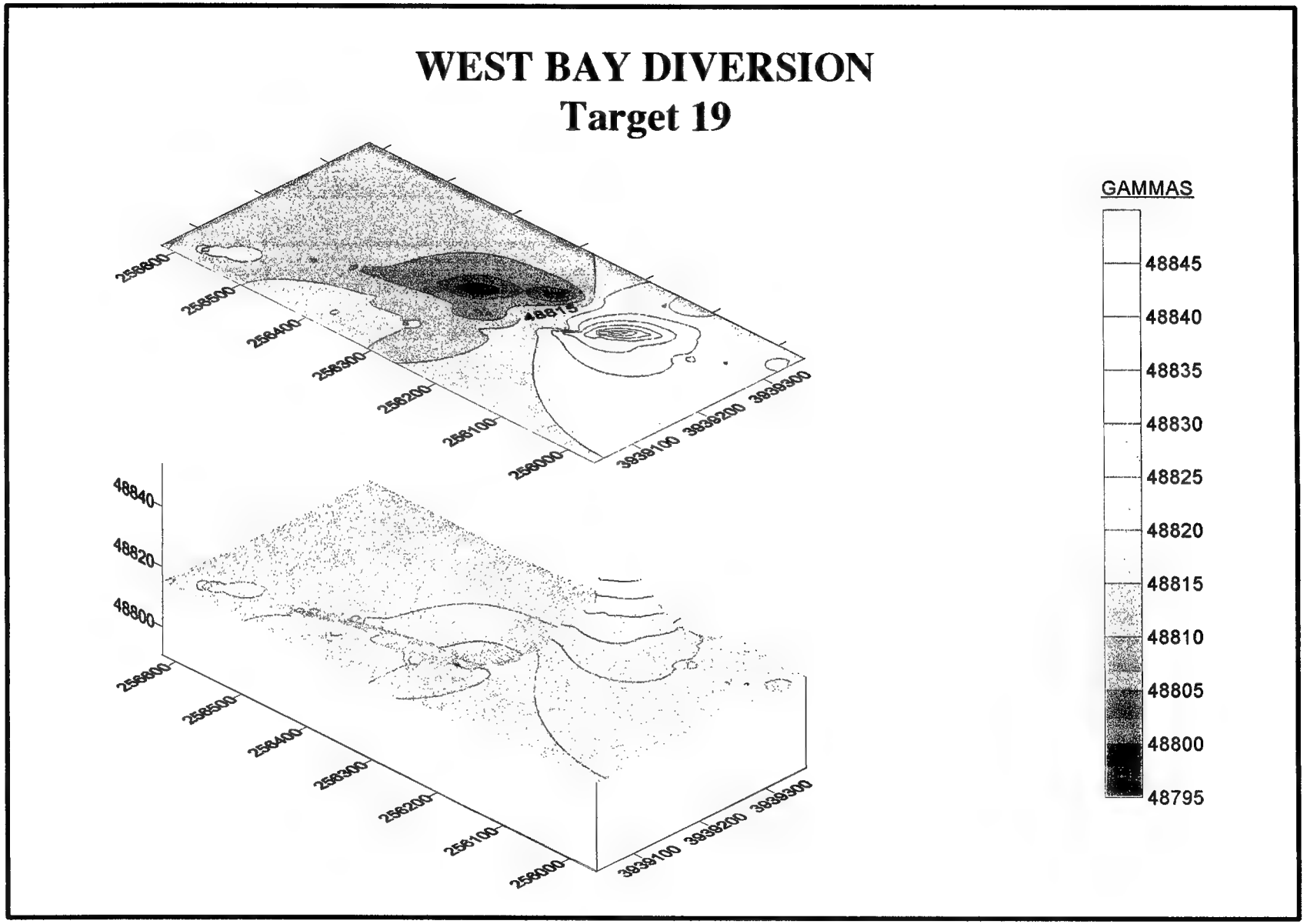


Figure 26. Magnetic contouring of Target 19.

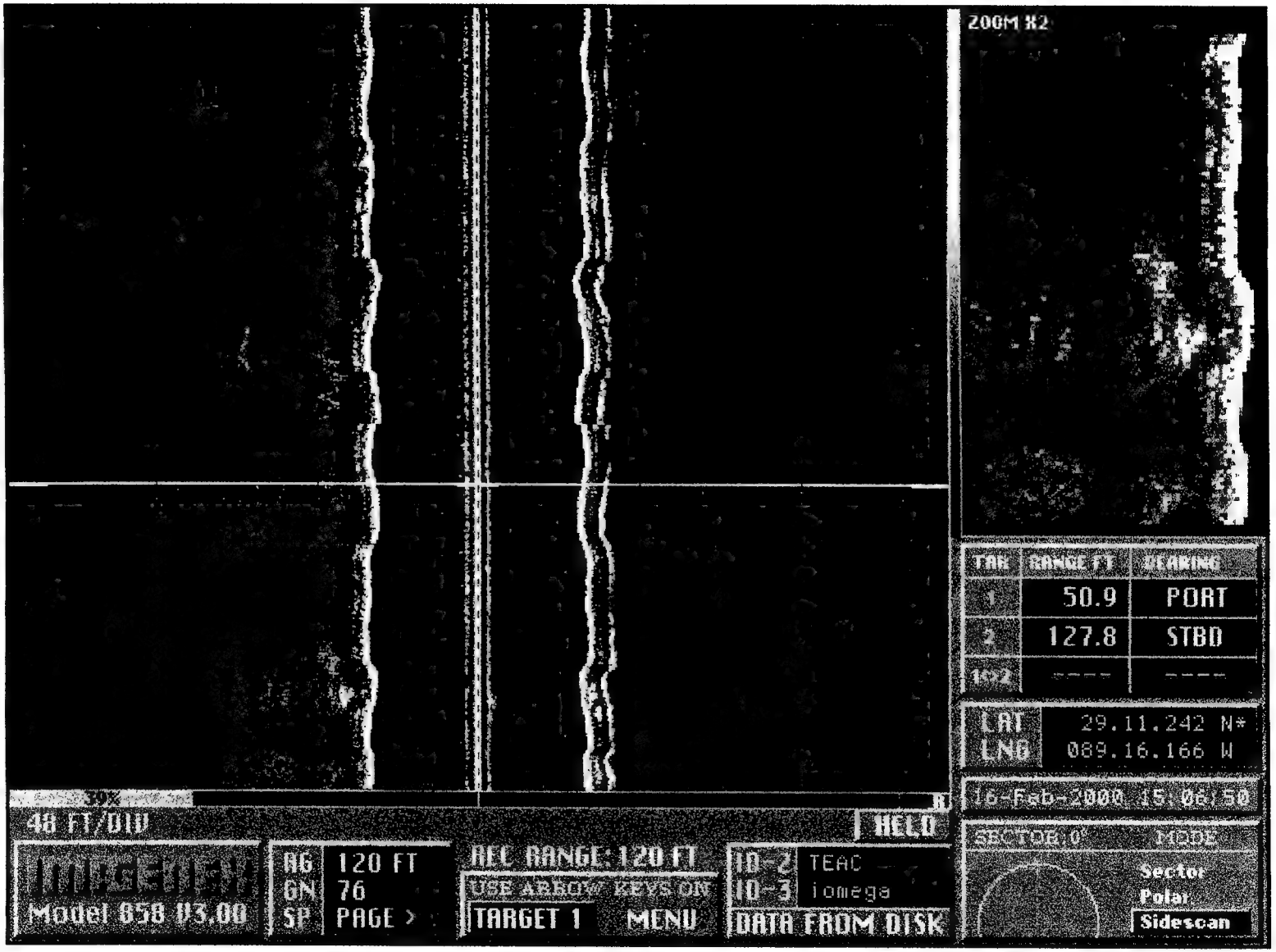


Figure 27. Imagenex 858 side scan sonar image associated with Target 19, acoustic 15, representing an area of scattered ferrous debris.

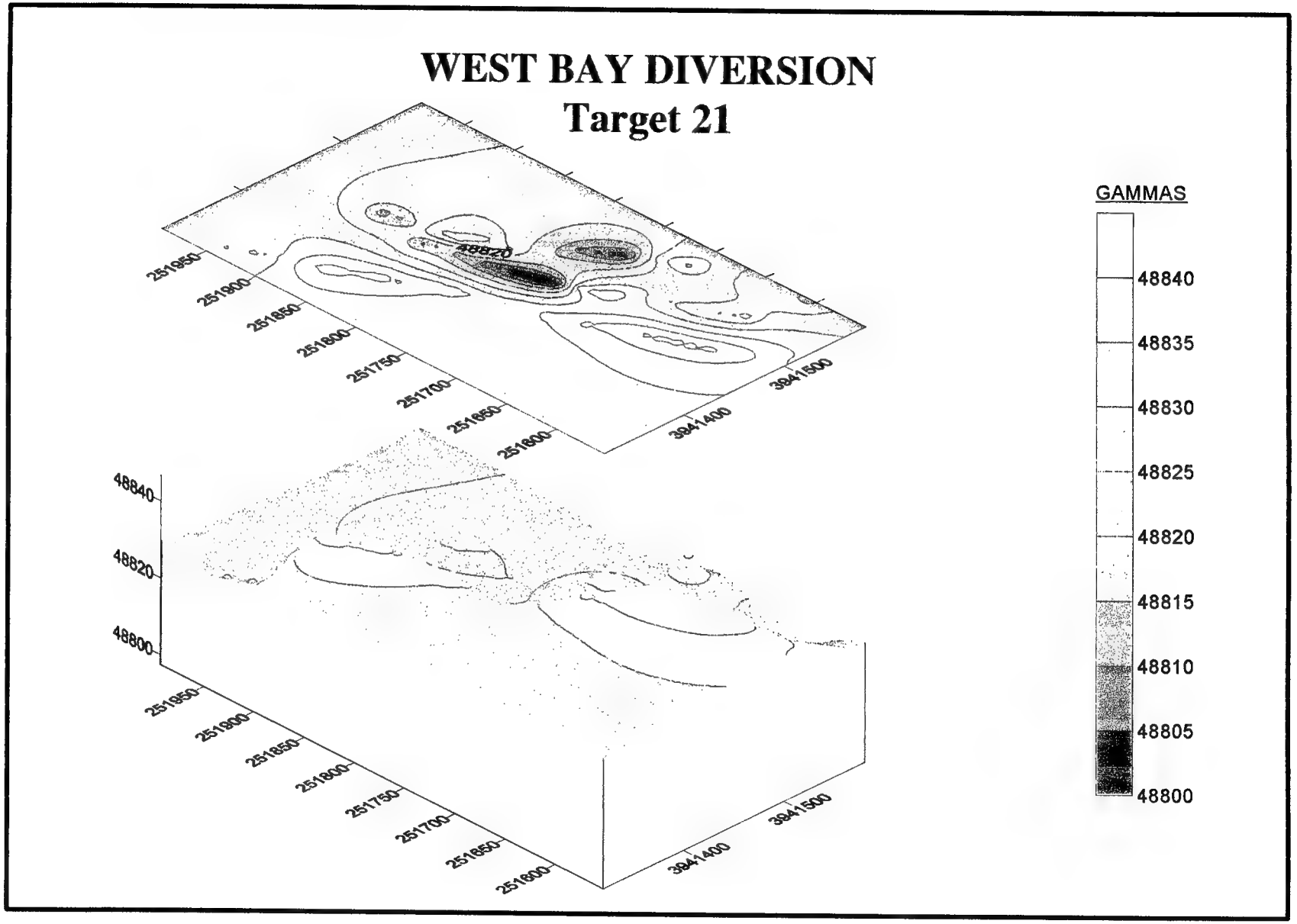


Figure 28. Magnetic contouring of Target 21.

CHAPTER VII

PROJECT SUMMARY AND MANAGEMENT RECOMMENDATIONS

This report presents the results of the Phase I Marine Archeological Remote Sensing Survey for the West Bay Diversion Project Area, in Plaquemines Parish, Louisiana. These investigations were conducted during February 13 – 20, 2000, by R. Christopher Goodwin & Associates, Inc., on behalf of the U.S. Army Corps of Engineers, New Orleans District (USACE-NOD). The study was undertaken to assist the USACE-NOD in satisfying its responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended.

The marine remote sensing survey, utilizing side scan sonar, recording proton precession magnetometer, DGPS, and a digital recording fathometer, produced 128 magnetic anomalies (Table 4), and 25 acoustic anomalies (Table 5). Additional post processing of the geophysical data established 22 target clusters (Table 6). Analysis of these data found six correlations between acoustic and magnetic disturbances, all of which either were associated with isolated debris, or were an artifact of dredging. Only two target clusters (Target 8, and Target 22) were associated with a possible shipwreck. However, the broad distribution pattern of Targets 8 and 22 suggests that these anomalies may be highly disarticulated vessel fragments, or the debris remaining from the destruction and removal of this wreck. Historic research indicates that this site is recent (no earlier that 1973), and a search of several state and federal shipwreck data bases failed to turn up additional data as to the nature of this wreck. An interview with several local experts on this reach of the Mississippi (Jimmy Scarabin and Marty Bauer, both with the U.S. Army Corps of Engineers, New Orleans District), indicates that this wreck is modern. Mr. Scarabin indicated that the study area was "rocked" (the bankline was armored with rip rap) during the mid to late sixties, and no vessel was encountered in the study area during that period. Due to the recent age of the wreck, and the lack of vessel integrity (as indicated through geophysical data interpretation), it does not meet the age or integrity requirements for listing in the National Register of Historic Places. No additional work is recommended for these targets.

The rest of the anomalies encountered during the marine cultural resource survey are not indicative of submerged cultural resources, and likely are associated with random modern ferrous scatter recorded throughout the study area. These anomalies do not comprise cultural resources, nor do they warrant further work or avoidance.

REFERENCES

Aitken, M. J.
1961 *Phiysics and Archeology*. Interscience, New York.

Bauer, Marty, US Army Corps of Engineers – New Orleans District
1999 Personal communication, February 15, 2000.

Baughn, William H.
1950 *The Impact of World War II on the New Orleans Port—Mississippi River Transportation System*. Division of Research, College of Commerce, Louisiana State University. Baton Rouge.

Bea, R. G., and J. M. E. Audibert
1980 Offshore Platforms and Pipelines in Mississippi River Delta. *Proceedings of the American Society of Civil Engineers* 106(GT8):853-869.

Benson, H. A., and R. A. Boland, Jr.
1986 *Mississippi River Passes Physical Model Study, Report 2, Shoaling and Hydrologic Investigations in Southwest Pass, Hydraulic Model Investigation.* Technical Report No. HL-86-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg.

Berman, Bruce D.
1972 *Encyclopedia of American Shipwrecks*. The Mariners Press Inc. Boston.

Biographical and Historical Memoirs of Louisiana.
1892 Vol. II. The Goodspeed Publishing Co.

Board of Commissioners of the Port of New Orleans
1925 *The Nation's Second Port, The South's Greatest City*. New Orleans.

Board of Engineers for Rivers and Harbors
1944 *Port and Terminal Facilities at the Ports of New Orleans and Lake Charles, La.* The War Department. Government Printing Office. Washington.

Boyd, C.H.
1868 Map: *Mississippi River from Cubit's Crevasse to the Forts and Shores of Bird Island Sound, La.* Chart No. 1069. Section VIII. National Archives, College Park, Maryland. Record Group 23, Entry 1069.

Bragg, Marion
1977 *Historic Names and Places on the Lower Mississippi River*. Mississippi River Commission. Vicksburg.

Breiner, Sheldon
1973 *Applications Manual for Portable Magnetometers*. Geometrics, Sunnyvale, California.

Bureau of the Census
1997 *County Business Patterns for Plaquemines Parish.* Internet: cbp@census.gov.

Carney, David
1984 *Final Environmental Impact Statement, Supplement II: Mississippi River, Baton Rouge to the Gulf, Louisiana Project.* United States Army Corps of Engineers, New Orleans District, New Orleans.

Chabreck, R. H., and G. Linscombe
1978 *Vegetative Type Map of the Louisiana Coastal Marshes.* Louisiana Department of Wildlife and Fisheries, New Orleans.

Chapelle, Howard I.
1951 *American Small Sailing Craft: Their Design, Development and Construction.* Norton and Company, Inc., New York.

Chase, James E., John L. Montgomery, G. Keith Landreth, and Kathleen M. Bowman
1988 *Southeast Louisiana Cultural Resource Management Plan.* United States Army Corps of Engineers, New Orleans District; and Agency for Conservation Archaeology Eastern New Mexico University Portales, New Mexico.

Chief of Engineers
1899 *Annual Report of the Chief of Engineers to the Secretary of War.* Government Printing Office. Washington.

1909 *Annual Report of the Chief of Engineers to the Secretary of War.* Government Printing Office. Washington.

1925 *Annual Report of the Chief of Engineers to the Secretary of War.* Government Printing Office. Washington

1936 *Annual Report of the Chief of Engineers to the Secretary of War.* Government Printing Office. Washington.

Clay, Floyd M.
1983 *History of Navigation on the Lower Mississippi.* Government Printing Office. Washington.

Clemensen, Berle
1983 *State of Louisiana Site Record Form, "Old Quarantine Station Site."* State Survey No. 16PL99.

Coastal Environments, Inc.
1977 *Cultural Resources Evaluation of the Northern Gulf of Mexico Continental Shelf.* Prepared for Interagency Archeological Services, Office of Archeology and Historic Preservation, National Park Service, U.S. Department of the Interior, Washington, D.C. Coastal Environments, Inc., Baton Rouge.

Coggins, J.
1962 *Arms and Equipment of the Civil War.* Doubleday and Co., Inc., Garden City, New York.

Coleman, J. M., and S. M. Gagliano
1964 Cyclic Sedimentation in the Mississippi River Deltaic Plain. *Transactions of the Gulf Coast Association of Geological Societies* 14:67-80.

Coleman, J. M., and H. H. Roberts
1991 The Mississippi River Depositional System: A Model for the Gulf Coast Tertiary. *An Introduction to Central Gulf Coast Geology*, pp. 99-121. Edited by D. Goldthwaite. New Orleans Geological Society, New Orleans.

Cowdrey, Albert E.
1971 *The Delta Engineers: A History of the United States Army Corps of Engineers in the New Orleans District.* U.S. Army Corps of Engineers, New Orleans District, New Orleans.

Davis, Dave. D., John D. Hartley and Ruth wiens Henderson
1979 *An Archeological and Historic Survey of the Lowermost Mississippi River: Cultural Resources Survey, New Orleans to Venice Hurricane Protection Levee: East Bank Barrier Levee Plan.* Submitted to the U.S. Army Corps of Engineers, New Orleans District.

Davis, George H.
1915 The Structures, Equipment and Advantages of the Port of New Orleans. An address before the New Orleans Association of Commerce.

District Engineering Officer
1916 Letter to the Chief of Engineers. From the District Engineer Office, Mobile, Alabama, United States Engineer Office, Mobile, Alabama, September 15, 1916. Record Group 77, Entry 78957/239 (General Correspondence).

Dorsey, Florence
1947 *Road to the Sea: The Story of James B. Eads and the Mississippi River.* Rinehart Company, New York.

Faye, S.
1940 Types of Privateer Vessels, their Armament and Flags, in the Gulf of Mexico. *The Louisiana Historical Quarterly* 23:118-130.

Fisk, H. N.
1961 Bar-finger Sands of Mississippi Delta. In: *Geometry of Sandstone Bodies.* American Association of Petroleum Geologists, Tulsa.

Fisk, H. N., and E. McFarlan, Jr.
1955 Late Quaternary Deltaic Deposits of the Mississippi River. In *The Crust of the Earth,* pp. 279-302. Geological Society of America Special Paper 62, Boulder, Colorado.

Frazier, D. E.
1967 Recent Deltaic Deposits of the Mississippi River: Their Development and Chronology. *Transactions of the Gulf Coast Association of Geological Societies* 17:287-315.

Gagliano, Sherwood M., Katherine L. Brooks and Ben A. Small
1978 *Cultural Resource Survey of Grand and Tiger Passes and Baptiste Collette Bayou, Plaquemines Parish, Louisiana.* Coastal Environments, Inc., Baton Rouge.

Garofalo, D., and Burk and Associates, Inc.
1982 *Mississippi Deltaic Plain Region Ecological Characterization: An Ecological Atlas.* Report No. FWS/OBS-81/16, U.S. Department of the Interior, Fish and Wildlife Service, Washington.

Garrison, Erwin G. and James G. Baker
1982 *A Technical Report on the Methodical Evaluation of Instrumental Search in the Lower Mississippi River, Venice, Louisiana to the Gulf of Mexico.* Enviromental Engineering Division Texas Engineering Experiment Station and Texas A&M Research Foundation. U.S. Corps of Engineers, New Orleans District, New Orleans.

Garrison, Ervan G., C.P. Giammona, F.J. Kelly, A.R. Tripp, and G.A. Wolff.
1989 *Historic Shipwrecks and Magnetic Anomalies of the Northern Gulf of Mexico.* Texas A&M Research Foundation, College Station, Texas. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office.

Gerdes, F.H
1862 Map: *Reconnaissance of the Mississippi River Below Forts Jackson and St. Philip Made Previous to the Reduction by the U.S. Fleet Under the Command of Flag Officer D.G. Farragut, U.S.N.* By the party under the direction of F.H. Gerdes, Asst. U.S. Coast Survey. Bowen & Co., Lithographers, Philadelphia.

Giardino, M. J.
1984 Documentary Evidence for the Location of Historic Indian Villages in the Mississippi Delta. In *Perspectives on Gulf Coast Prehistory.* Edited by D. D. Davis, pp. 232-257. University Presses of Florida, Gainesville.

Goodwin, R. Christopher, Kenneth R. Jones, Debra M. Stayner, and Galloway W. Selby
1985 *Evaluation of the National Register Eligibility of Burrwood, Plaquemines Parish, Louisiana.* R. Christopher Goodwin & Associates, New Orleans.

Goodwin, R. Christopher, Jean Pelletier, M.A., David W. Trubey, B.A., John L. Czarzasty, M.A., and Richard Vidutis, Ph.D.
1999 *Cultural Resources Survey and Inventory Results of the Proposed 36-inch Gas Pipeline Mobile Bay to Florida Three League Line.* R. Goodwin & Associates, Frederick, Maryland.

Goodwin, R. Christopher, JeanPelletier, M.A., David W. Trubey, B.A., Roger Saucier, Ph.D., Ralph Draughon, Jr., Ph.D., and Martha R. Williams, M.A., M.Ed.
1999 *Phase I Marine Archeological Remote Sensing Survey of Segments Along the Southwest Pass of the Mississippi River, Plaquemines Parish, Louisiana.* R. Goodwin & Associates, Frederick, Maryland.

Gould, E. W.
1889 *Fifty Years on the Mississippi: or, Gould's History of River Navigation.* Nixon-Jones Printing Company, St. Louis.

Green, Jeremy
1990 *Maritime Archaeology: A Technical Handbook.* Academic Press, New York.

Hall, E. T.
1966 The Use of a Proton Magnetometer in Underwater Archeology. *Archaeometry* 9:32-44.

1970 Survey Techniques in Underwater Archeology. *Philosophical Transactions of the Royal Society*, London A.269:121-124

Hamilton, Earl J.
1934 *American Treasure and the Price of Revolution in Spain, 1501-1650.* Harvard University Press, Cambridge, Massachusetts.

Hemphill, James E.
1998 *Beneath the Waters: A Guide to Civil War Shipwrecks.* Burd Street Press, Shippensburg, Pennsylvania.

Hoffman, Paul E.
1980 *The Spanish Crown and the Defense of the Caribbean, 1535-1585.* Louisiana State University. Baton Rouge.

Howard, F.
1979 *Sailing Ships of War, 1400-1860.* Conway Press, Greenwich.

Hydrographic Office, U.S. Navy
1942 Map: *Gulf of Mexico*. Overprint showing military vessel wrecks on U.S. Coast and Geodetic Survey Chart No. 1007-A. Corrected to November 1, 1942, from the *Hydrographic Office Wreck Information List*. Washington, D.C.

1945 *Hydrographic Office Wreck Information List.* Compiled by the U.S. Hydrographic Office from all available sources. Corrected to March 10, 1945. Published Under the Authority of the Secretary of the Navy. Government Printing Office. Washington.

1943-1976 *Notices to Mariners*. Government Printing Office. Washington.

Irion, Jack B.
1985 *Archaeological Testing of the Confederate Obstructions, 1Mb28, Mobile Harbor, Alabama*. U.S. Army Corps of Engineers. Prepared by Espey, Huston, and Associates, Inc., Austin, Texas.

1986 *Underwater Archaeological Investigations, Mobile Bay Ship Channel*. U.S. Army Corps of Engineers. Prepared by Espey, Huston, and Associates, Inc., Austin, Texas.

Jackson, H. Edwin, Jr.
1979 *A Cultural Resources Survey of the Delta-Breton National Wildlife Refuge, Louisiana.* U.S. Fish and Wildlife Service. Prepared by Heartfield, Price & Greene, Inc., Monroe, Louisiana.

Kolb, C. R., and R. I. Kaufman
1967 Prodelta Clays of Southeast Louisiana. In *Marine Geotechnique,* edited by A.F. Richards. University of Illinois Press, Urbana.

Kolb, C. R., and J. R. VanLopik
1958 *Geology of the Mississippi River Deltaic Plain, Southeastern Louisiana.* Technical Report No. 3-483, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

Laing, A.
1974 *The American Heritage History of Seafaring America.* McGraw-Hill, New York.

Lawson, Edward W.
1946 *The Discovery of Florida and Its Discoverer*, Juan Ponce De Leon. St. Augustine.

Leeper, Clare D'Artois
1976 *Louisiana Places: A Collection of the Columns from the Baton Rouge.* Sunday Advocate, *1960-1974.* Legacy Publishing Co., Baton Rouge.

Lincoln, Rod
1983 The Balize 1718-1722. *Deep Delta Quarterly* 1:331-338.

Lonsdale, Adrian and H.R. Kaplan
1964 *A Guide to Sunken Ships in American Waters.* Compass Publications, Inc., Arlington, Virginia.

Lyon, Edwin A. US Army Corps of Engineers Contracting Officers Representative – New Orleans District
1999 Personal communication, November 24, 1999.

MacLeisch, W.H.
1989 "The Blue Gold." *Smithsonian* 19(11):44-61.

May, J. R., and L. D. Britsch
1987 *Geologic Investigation of the Mississippi River Deltaic Plain: Land Loss and Land Accretion.* Technical Report No. GS-87-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg.

McChesney, Tiley S.
1920 *Port and Terminal Facilities.* New Orleans.

McIntire, W. G.
1958 *Prehistoric Indian Settlements of the Changing Mississippi River Delta.* Coastal Studies Series No. 1, Louisiana State University Press, Baton Rouge.

Meyer, Sr., J. Ben
1981 *Plaquemines: The Empire Parish.* Laborde Printing Co., Inc., N.p.

Mistovich, Tim S., Vernon James Knight, Jr., George M. Lamb, and Eugene M. Wilson.
1983 *Cultural Resources Survey of Mobile Harbor, Alabama.* U.S. Army Corps of Engineers. Prepared by OSM Archaeological Consultants, Inc., Moundville, Alabama.

Mitchell, C. Bradford (ed.)
1975 *Merchant Steam Vessels of the United States 1790-1868.* ("The Lytle-Holdcamper List"). The Steamship Historical Society of America, Staten Island, New York.

Montgomery, John L., Keith Landreth, Joan Exnicios, Kathleen Bowman, and James Bowman.
1988 *Final Report of Cultural Resource Investigations within the U.S. Army Corps of Engineers New Orleans To Venice Hurricane Protection Project.* Agency for Conservation Archaeology Eastern New Mexico University, Portales, New Mexico. Submitted to U.S. Army Corps of Engineers, New Orleans District, New Orleans.

Morgan, Arthur E.
1971 *Dams and Other Disasters*. Porter Sargent, Boston.

Morison, Samuel Eliot
1961 *The Battle of the Atlantic, September 1939-May 1943*. Little-Brown and Company, Boston.

Muller, John W.
1985 *Deep Draft Report: A Survey of the Underwater Portions of the Baton Rouge to the Gulf, Deep Draft Access Project. Venice to the Gulf Segment, Including Supplement II to the Mississippi River, Baton Rouge to the Gulf EIS.* N.p., N.d.

Murray, G.E.
1961 *Geology of the Atlantic and Gulf Coastal Province of North America.* Harper and Brothers, New York.

Nevins, A.
1946 Sail On. The Story of the American Merchant Marine. U.S. Lines Co. *New York Times*, 1929. March 23, 1946, pp. 2-4.

NOAA
1999 *AWOIS* (Automated Wreck and Obstruction Information System). U.S. Department of Commerce. National Oceanic and Atmospheric Administration. Washington, D.C.

1999 *Mississippi River Delta*. Nautical Chart No. 11361. National Oceanic and Atmospheric Administration. Washington, D.C.

Office of the Chief of Engineers
1875a Map: *Hydrography of Part of Mississippi River, Louisiana*. Copied from the original Ms. map (by F.H. Gerdes, 1866), loaned by the Coast Survey of Coast Survey map. Washington, D.C.

1875b Map: *Head of Passes, Mississippi Delta and Up the River to Cubbitt's Crevasse*. Reduced from the original Ms. (Coast Survey) map, on a scale of 1:2,400.Washington, D.C.

Oliver, John W.
1956 *History of American Technology*. The Ronald Press Co., New York.

O'Neil, T.
1949 *The Muskrat in the Louisiana Coastal Marshes*. Louisiana Department of Wild Life and Fisheries, New Orleans.

Parker, Walter
1924 Realization of a New Character of Port Economy. *Marine Engineering and Shipping Age* 29:481-484.

Pearson, Charles E., George J. Castille, Donald Davis, Thomas E. Redard, and Allen R. Saltus
1989 *A History of Waterborne Commerce and Transportation Within the U.S. Army Corps of Engineers New Orleans District and an Inventory of Known Underwater Cultural Resources*. Coastal Environments, Baton Rouge.

Priestly, Herbert Ingram
1928 *The Luna Papers: Documents Relating to the Expedition of Don Tristan de Luna y Arrellano for the Conquest of La Florida in 1559-1561*. Two volumes. Delaqnd, Florida.

Roberts, Robert B.
1988 *Encyclopedia of Historic Forts: The Military, Pioneer, and Trading Post of the United States*. Macmillan Publishing Co., New York.

Rohwer, J.
1983 *Axis Submarine Successes, 1939-1945*. The Naval Institute Press. Annapolis, Maryland.

Russell, R. J.
1936 Physiography of Lower Mississippi River Delta. In *Lower Mississippi River Delta, Reports on the Geology of Plaquemines and St. Bernard Parishes*. Geological Bulletin No. 8, Louisiana Geological Survey, New Orleans.

Saucier, R. T.
1994 *Geomorphology and Quaternary Geologic History of the Lower Mississippi Valley*. U.S. Army Corps of Engineers, Mississippi River Commission, Vicksburg, Mississippi.

Scarabin, James, Corps of Engineers, Venice, Louisiana
2000 Personal communication with J.B. Pelletier.

Sea Technology.
1986. Editors Corner, p. 69.

Secretary of the Army
1996 *Report of the Secretary of the Army on Civil Works Activities for Fiscal Year 1996*. Government Printing Office, Washington.

Singer, Steven D.
1998 *Shipwrecks of Florida: A Comprehensive Listing*. Pineapple Press, Inc., Sarasota.

Stewart, Charles W.
1903 *Official Records of the Union and Confederate Navies in the War of the Rebellion*. First Series. Volume 16. Government Printing Office, Washington.

Stringfield, William Richard
2000 *Le Pays des Fluers Oranges*.
Internet: ftp.rootsweb.com/pub/usgenweb/la/plaquemi/book.

Stuart, David R., and Jerome A. Green
1983 *An Archeological Survey of the Proposed Venice Revetment (M-18.7 to 10.5-R), Plaquemines Parish, Louisiana*. National Park Service Center Southeast-Southwest Team. Submitted to U.S. Army Corps of Engineers, New Orleans District, New Orleans.

Surrey, N.M. Miller
1916 *The Commerce of Louisiana During the French Regime, 1699-1763.* Studies in History, Economics and Public Law, Vol. LXXI, No. 1., Columbia University.

Tite, M.S.
1972 *Methods of Physical Examination in Archeology.* Seminar Press, New York.

U.S. Coast Guard
2000 *Aids to Navigation.* U.S. Department of Commerce. United States Coast Guard.

U.S. Coastal and Geodetic Survey
1874 Chart No. 94. *Mississippi River From the Passes to Grand Prairie, Louisiana.* National Archives, College Park, Maryland. Record Group 23, Entry 194G.

1957 Chart No. 1272. West Delta quad.

U.S. Congress
1837 Letter by William H. Chase, Captain of Engineers, to General Charles Gratiot, Chief Engineer, United States. In *Survey of the Mississippi River.* Message from the President of the United States Transmitting Documents in Relation to the Survey of the Mississippi River. Executive Document No. 173. House of Representatives, Executive Documents. 24th Congress, 2nd Session. Washington, D.C.

1858 *Deepening Channels of Southwest Pass and Pass À L'Outre.* Message from the President of the United States Transmitting Copies of Contracts for Deepening the Channels of Southwest Pass and Pass à l' Outre, at the mouth of the Mississippi River. Executive Document No. 139. House of Representatives, Executive Documents. 35th Congress, 1st Session. Washington, D.C.

1866 *Navigation of the Southwest Pass.* 39th Congress, 1st Session. U.S. House Document No. 97. Washington, D.C.

1939 *Mouth of Mississippi River, LA.* 76th Congress, 1st Session. House Document No. 215. Washington, D.C.

1944 *Intercoastal Waterway From the Mississippi River at New Orleans, LA.*, to Corpus Christi, Tex. 78th Congress, 2nd Session. Senate Document No. 188. Washington, D.C.

U.S. Navy
1999 NIMA (National Image and Mapping Agency). Washington, D.C.

Way, Jr., Frederick
1983 *Way's Packet Directory, 1848-1994. Passenger Steamboats of the Mississippi River System System Since the Advent of Photography in Mid-Continent America.* Ohio University Press, Athens.

Way, Jr., Frederick and Joseph W. Rutter
1990 *Way's Steam Towboat Directory.* Ohio University Press, Athens.

Weddle, R.S.
1985 *Spanish Sea: The Gulf of Mexico in North American Discovery, 1500-1685.* Texas A&M University Press, College Station, Texas.

1987 *La Salle, the Mississippi, and the Gulf.* Texas A&M University Press, College Station, Texas.

Welder, F. A.
1959 *Processes of Deltaic Sedimentation in the Lower Mississippi River.* Technical Report No. 12, Coastal Studies Institute, Louisiana State University, Baton Rouge.

Weymouth, John W.
1986 Geophysical Methods of Archaeological Site Surveying. In *Advances in Archaeological Method and Theory, Volume 9.* Academic Press, New York.

Wilds, John, Charles L. Dufour, and Walter G. Cowan
1996 *Louisiana Yesterday and Today: A Historical Guide to the State.* Louisiana State University Press, Baton Rouge.

Wilson, Eugene
1983 A Typology of Vessels Known to Have Been Used in the Mobile Bay Region from the Sixteenth through the Twentieth Century. In *Cultural Resources Survey of Mobile Harbor, Alabama,* by T. S. Mistovich and V. J. Knight, Jr. OSM Archaeological Consultants, Inc., Moundville, Alabama.

Worchester, Donald E., and Wendell G. Schaeffer
1956 *The Growth and Culture of Latin America.* Oxford University Press, New York.

APPENDIX I

SCOPE-OF-WORK

Scope of Services
Remote Sensing Survey of the West Bay Diversion, Anchorage Area and the Sediment Retention Enhancement Device (SRED) area, Louisiana

1. Introduction. This task order requires the performance of a remote sensing survey designed to locate submerged cultural resources that may be impacted by dredging in the Southwest Pass for an Anchorage Area. This project area is located adjacent to the channel in Southwest Pass. This task order also includes conducting a magnetomer search of the Sediment Retention Enhancement Device structure to locate any pipelines or other features along the proposed route.

The Mississippi River had been an important navigation route since prehistoric times. Prehistoric vessels were used in river waters for transportation and commerce in the colonial period. Waterborne commerce was associated with French and Spanish trade and transportation routes. In the 19th Century more and more plantations and towns were established along the river and its distributaries. Boat landings existed up and down the River. Steamboats, barges, and various ships plied the waters carrying sugar, cotton, and other goods as well as passengers.
The number of recorded shipwrecks represents only a small fraction of the wrecks that are expected to exist in the project vicinity. The project area, as a portion of the Louisiana coastal waters, had the potential to contain colonial era (ca. 1718-1803) shipwrecks. The 1979 discovery of the El Nuevo Constante, a Spanish sailing vessel lost in 1766 in similar waters off the coast of Cameron Parish, amply illustrates this potential. The probability for shipwrecks in the project vicinity increase for nineteenth and twentieth century vessels due to the increased maritime commerce in the region.

A brief navigational history of the coastal water of the Gulf of Mexico and an inventory of known shipwrecks in the study area is provided in the report entitled A History of Waterborne Commerce And Transportation Within the U.S. Army Corps of Engineers, New Orleans District and an Inventory of Known Underwater Cultural Resources prepared by Coastal Environments, Inc. This study documents several shipwrecks in the vicinity of the project area.

2. Study Area. The study area consists of the designated West Bay Diversion Anchorage Area and the sediment retention enhancement device (SRED) referenced above. Southwest Pass is located at the gulf ward end of Mississippi River. The anchorage area is approximately 5 miles long and 500 feet wide running

adjacent to the Southwest Pass channel (Figure 1). The SRED area is located to the west of Southwest Pass as indicated on Figure 1. The coordinates are listed in enclosure 1.

3. General Nature of the Work. The purpose of this study is to locate and identify historic shipwrecks in the above noted project area. The study will employ a systematic magnetometer and side scan sonar survey of the study area using precise navigation control and a fathometer to record bathymetric data. All potentially significant anomalies will be briefly investigated via additional intensive survey and probing of the water bottom (if possible). No diving will be performed under this delivery order.

This task order also requires a magnetomer survey of the Shred area to locate any submerged magnetics like pipelines and so forth. An airboat will be necessary given the shallow depths of the water in the area.

The project requires historic background research, followed by the intensive survey of the two areas. An inventory of all magnetic, sonar, and bathymetric anomalies will be prepared. The background research, field survey, and data analyses will be documented in a brief management summary and comprehensive technical report.

4. Study Requirements. The study will be conducted utilizing current professional standards and guidelines, including, but not limited to:

the National Park Service's National Register Bulletin entitled "How to Apply the National Register Criteria for Evaluation";

the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation as published in the Federal Register on September 29, 1983;

Louisiana's Comprehensive Archeological Plan dated October 1, 1983;

the Advisory Council on Historic Preservation's regulation 36 CFR Part 800 entitled, "Protection of Historic Properties" and

the Louisiana Submerged Cultural Resources Management Plan published by the Louisiana Division of Archaeology in 1990.

The study will be conducted in three phases: review of background sources, remote sensing survey, and data analyses

and report preparation.

Phase 1. Review of Background Sources. Due to the availability of the study referenced in Section 2 above, this phase is limited to a brief review of pertinent information contained in the referenced CEI report, Chief of Engineers reports, and general histories of the parishes covering the project.

In addition to reviewing the cultural background of the project area, geological and sedimentological studies will be examined to develop a concise summary of the physical environment of the project areas. This investigation specifically will examine issues relating to wreck dispersion and preservation as well as channel changes.

Phase 2a. Remote Sensing Survey. Upon completion of Phase 1, the contractor shall proceed with execution of the fieldwork. The equipment array required for this survey effort is:

(1) a marine magnetometer;
(2) a differential GPS positioning system;
(3) a recording fathometer;
(4) a side scan sonar system.

The Contracting firm may propose additional equipment such as sub-bottom profiler and so forth as long as they can provide information in the technical proposal as to what kind of additional data would be obtained from its use. Three estimates must be provided if the contractor does not own the equipment to be used.

The following requirements apply to the survey:

(1) transect lane spacing will be no more than 50 feet;
(2) positioning control points will be obtained at least every 100 feet along transects;
(3) background noise will not exceed +/- 3 gammas;
(4) magnetic data will be recorded on 100 gamma scale;
(5) the magnetometer sensor will be towed a minimum of 2.5 times the length of the boat or projected in front of the survey vessel to avoid noise from the survey vessel;
(6) the survey will utilize the Louisiana Coordinate System.

Phase 2b. Definition of Anomalies. Additional, more tightly spaced transects will be conducted over potentially significant anomalies if necessary to provide more detail on site configuration and complexity. Probing of the water bottom will be performed at all potentially significant anomalies where water depths and weather conditions permit.

Phase 3: Data Analyses and Report Preparation. All data will be analyzed using currently acceptable scientific methodology. The post-survey data analyses and report presentation will include as a minimum:

(1) Post-plots of survey transects, data points and bathymetry;
(2) same as above with magnetic data included;
(3) plan views of all potentially significant anomalies showing transects, data points, magnetic and depth contours;
(4) correlation of magnetic, sonar and fathometer data, where appropriate; and
(5) high quality reproduction of sonar records related to potentially significant anomalies.

The interpretation of identified magnetic anomalies will rely on expectations of the character (i.e. signature) of shipwreck magnetics derived from the available literature. Interpretation of anomalies will also consider probable post-depositional impacts, and the potential for natural and modern, i.e. insignificant sources of anomalies.

The report shall contain an inventory of all magnetic, sonar, and bathymetric anomalies recorded during the underwater survey, with recommendations for further identification and evaluation procedures when appropriate. These discussions must include justifications for the selection of specific targets for further evaluation. Equipment and methodology to be employed in evaluation studies must be discussed in detail.

A product to be provided under this delivery order and submitted with the draft reports will include CAD graphics and/or design files compatible with the NOD Intergraph system. The maps and supporting files generated from marine survey data will show, at a minimum, the survey coverage area, the locations of all anomalies and other pertinent features such as: channel beacons and buoys, channel alignments, bridges, cables and pipeline crossings. Tables listing all magnetic anomalies recorded during the survey will accompany the maps. At a minimum, the tables will include the following information: Project Name; Survey Segment/Area; Magnetic Target Number; Gammas Intensity; Target Coordinates (Louisiana State Plane).

If determined necessary by the COR, the final report will not include detailed site location descriptions, state plane or UTM coordinates. The decision on whether to remove such data from the final report will be based upon the results of the survey. If removed from the final report, such data will be provided in a separate appendix. The analyses will be fully documented. Methodologies and assumptions employed will be explained and

justified. Inferential statements and conclusions will be supported by statistics where possible. Additional requirements for the draft report are contained in Section 6 of this Scope of Services.

5. Reports.

Management Summary. Three copies of a brief management summary, which presents the results of the fieldwork, will be submitted to the COTR within 1 week of completion of the survey area. The report will include a brief summary of the historical research and field survey methods by waterway, as well as descriptions of each anomaly located during the survey. Recommendations for further identification and evaluation procedures will be provided if appropriate. A preliminary map will be included showing the locations of each anomaly. A summary table listing all anomalies will be included with the maps. The table will include the following information: Project Name; Survey Segment/Area; Magnetic target number; Gammas Intensity; Target Coordinates (Louisiana State Plane).

Draft and Final Reports (Phase 1-3). Four copies of the draft report integrating all phases of this investigation will be submitted to the COR for review and comment within 12 weeks after work item award. The digitized project maps will also be submitted with the draft report.

The written report shall follow the format set forth in MIL-STD-847A with the following exceptions: (1) separate, soft, durable, wrap-around covers will be used instead of self covers; (2) page size shall be 8 1/2 x 11 inches with 1-inch margins; (3) the reference format of American Antiquity will be used. Spelling shall be in accordance with the U.S. Government Printing Office Style Manual dated January 1973.

The COR will provide all review comments to the Contractor within 8 weeks after receipt of the draft reports (20 weeks after work item award). Upon receipt of the review comments on the draft report, the Contractor shall incorporate or resolve all comments and submit one preliminary copy of the final report to the COR within 4 weeks (24 weeks after work item award). Upon approval of the preliminary final report by the COR, the Contractor will submit one reproducible master copy, one copy on floppy diskette, one copy on CD-ROM containing report in .pdf format, and 40 copies of the final report to the COR within 19 weeks after work item award.

APPENDIX II

RESUMES OF KEY PROJECT PERSONNEL

R. CHRISTOPHER GOODWIN, Ph.D.
PRESIDENT & CEO

Dr. R. Christopher Goodwin, is President and Director of Research of R. Christopher Goodwin & Associates, Inc., a preservation planning, environmental management, and forensic sciences firm with offices in Frederick, Maryland, New Orleans, Louisiana, Tallahassee, Florida, Hampton, Virginia, and Birmingham, Alabama. A native of Maryland, he is a former Yale Peabody Museum Research Associate (1976), Arizona State University Fellow, and Smithsonian Institution (1979-1980) Research Fellow and Scholar-in-Residence. Dr. Goodwin holds degrees in Anthropology/Archeology from Tulane (B.A.), Florida State (M.S.), and Arizona State (Ph.D.) Universities; the latter institution named him a "College of Liberal Arts Leader," in 1997.

Dr. Goodwin is recognized as one of the nation's leading experts in cultural resource management. He has been a contractor to the U.S. Army Corps of Engineers (Baltimore, Memphis, Nashville, New Orleans, Pittsburgh, Savannah, St. Louis, and Vicksburg Districts), to the Naval Facilities Engineering Command, and to the Department of Defense on numerous projects. During the past 18 years, he has served as Principal Investigator for major cultural resource investigations conducted by his firm in the Mid-Atlantic, Southeastern, Western, and Caribbean Regions. These projects have included such large-scale efforts as the architectural and archeological investigations at Baltimore's Oriole Park at Camden Yards stadium site; the new Baltimore Ravens Stadium; and the Washington Redskins' Jack Kent Cooke Stadium.

Dr. Goodwin's expertise also has been called upon for historic preservation planning projects, and for industrial and governmental agency compliance with federal and state laws and regulations governing archeological and historic sites. He has served as Principal Investigator on preservation and compliance projects for the National Capital, Southeast, and Southwest regions of the National Park Service (NPS); the Department of Energy (DOE); Her Majesty's Service, U.K.; the Louisiana Division of Archaeology; major utility companies, including Allegheny Power, ENRON, Texaco, Southern Natural Gas (SONAT), ANR/Coastal, Baltimore Gas and Electric Company, and Peabody Coal; the U.S. Fish and Wildlife Service, Northeast Region; the City of Annapolis; and, the Maryland Historical Trust. The geographic range of research and compliance projects completed under Goodwin's direction encompasses the Leeward Islands, Puerto Rico, the Bay Islands of Honduras, Maryland, Virginia, West Virginia, Pennsylvania, Ohio, Illinois, Arkansas, Florida, Georgia, Louisiana, Mississippi, California, and Texas.

Dr. Goodwin has published widely in the fields of prehistoric and historic archeology, and ethnohistory. His areas of particular expertise include preservation planning, cultural resource management, cultural ecology, prehistoric demography, field methods in archeology, human osteology, and historic archeology. He is a court-qualified expert in both historic archeology and in cultural resource management. In 1992, he was a recipient of the National Trust for Historic Preservation's National Preservation Honor Award for his work at Maryland's oldest surviving historic building, the Third Haven Meeting House, and of the Anne Arundel County Trust for Historic Preservation's Achievement in Archeology Award in 1992 and 1993. In 1997, he received the United States Small Business Administration's Administrators Award of Excellence, for "Outstanding Contribution and Service to the Nation," and the Maryland Historical Trust's Educational Excellence Award.

In addition to numerous technical reports and monographs, Dr. Goodwin has contributed to numerous scholarly journals, including *American Anthropologist, American Antiquity*, the *Florida Anthropologist*, and *American Scientist*. Dr. Goodwin is listed in *Who's Who in Leading American Executives* and *Who's Who Among Outstanding Americans*.

JEAN B. PELLETIER, M.A.
NAUTICAL ARCHEOLOGIST/REMOTE SENSING SPECIALIST

Jean B. Pelletier, M.A., graduated from the University of Maine in 1991 with a Bachelors degree in Geological Sciences, and received a Master of Arts degree in History from the University of Maine in 1998. His research interests include maritime history and nautical archaeology, steamboat technology, industrial technology, remote sensing, geophysics, scientific diving technology, and underwater photography/videography. Mr. Pelletier has formal training in marine geophysics, marine and terrestrial remote sensing, remotely operated vehicles, underwater video and diving safety, and has conducted archaeological, archival, and geophysical investigations in Alabama, Connecticut, Delaware, District of Colombia, Florida, Georgia, Illinois, Louisiana, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, and Virginia. As a graduate student at the University of Maine, Mr. Pelletier worked with Dr. Warren C. Riess as a research assistant on the Penobscot Expedition Phase II, conducting remote sensing and underwater documentation of the ships of the Penobscot Expedition.

Before joining Goodwin & Associates Inc., in 1997, Mr. Pelletier served as an archeological and scientific diving consultant for several universities and public utility companies along the Atlantic seashore. In this capacity, Mr. Pelletier managed the recovery of nine cannons from the *Nottingham Galley*, an eighteenth century English merchant ship lost on the ledges of Boon Island, Maine.

Since joining Goodwin & Associates, Inc., Mr. Pelletier has been involved in numerous Phase I, II, and III archaeological investigations of underwater sites. He has conducted remote sensing surveys in the Puerto Rico, Gulf of Mexico, Chesapeake Bay, and a Phase III recordation of the steamboat *Kentucky*, a confederate troop-transport lost on the Red River in 1865, near Shreveport, Louisiana. Mr. Pelletier's professional affiliations include: American Academy of Underwater Sciences, Marine Archaeology and Historical Research Institute (MAHRI), and the Society for Historical Archaeology.

SARAH A. MILSTEAD POST
NAUTICAL ARCHAEOLOGIST / SCIENTIFIC DIVER/ ASSISTANT CONSERVATOR

Sarah Milstead Post graduated from the University of Texas at Austin in 1995 with a Bachelors degree in Archaeology. Mrs. Post will be receiving a Masters of Arts degree in Maritime History and Nautical Archaeology from East Carolina University in 2001. Her experience and education in nautical archaeology has led to interests in remote sensing, scientific diving, ship construction, maritime history, cultural resource management, and conservation. She has formal training in all of these areas and has been involved with projects in Texas, Louisiana, North Carolina, Virginia, Bermuda, Belize, and Maine. As an undergraduate, Ms. Post worked as an intern for Barto Arnold at the Texas Historical Commission (THC) dealing with all phases of underwater archaeology. She was also on the team of nautical archaeologists with the THC in 1995 that discovered the *La Belle Wreck* that dates to the seventeenth century.

Before joining Goodwin and Associates Inc. in 1999, Mrs. Post was a crew chief for field schools at East Carolina University while also finishing classes for her Masters degree. She has worked on many nineteenth century sites mapping, excavating, and conserving artifacts from shipwrecks. Since joining Goodwin & Associates Inc., Mrs. Post has conducted Phase I marine remote sensing surveys in Louisiana and Virginia, and Phase II underwater surveys dealing with historic and prehistoric surfaces in Louisiana, Alabama, Florida, Virginia, and Maryland. She has also conserved many land and underwater artifacts dating from the seventeenth century to the nineteenth century. Mrs. Post's professional affiliations include: the Society of Historical Archaeology and American Academy of Underwater Sciences.

LARKIN A. POST, B.A.
NAUTICAL ARCHEOLOGIST/DIVE SAFETY OFFICER

Larkin A. Post graduated from the University of Maine in 1995 with a double major in anthropology and history. He attended the Maritime History and Nautical Archaeology program at East Carolina University (ECU). At that institution organized and led the largest student project in the program's history, for which work he should receive his M.A. in late 1999. Mr. Post is also a fully certified NAUI scuba instructor, ASHI first aid & CPR instructor, and American Red Cross Water Safety Instructor. As Goodwin and Associate's Dive Safety Officer (DSO) Mr. Post is responsible for all dive operations of the company and maintain Goodwin's status as currently the only private company that is a member of the prestigious American Academy of Underwater Sciences.

Mr. Post grew up working on the family's coastal Maine island and worked on local fishing boats from a young age. In spite of this he still retains a research interests in nautical archaeology, naval history and maritime industrial technology. Professional interests include remote sensing, navigation, remote piloted vehicle operation, and technical scuba diving. These skills have allowed Mr. Post to work on Phase I, II, III maritime archaeological projects in Maine, Massachusetts, Maryland, North Carolina, Bermuda, and Louisiana.

Before joining Goodwin and Associates, Mr. Post served as remote sensing and boat specialist for ECU. He also helped teach classes in remote sensing and was in charge of logistical setup and day to day operation several of the university's maritime projects. Finally for ECU he served as crew chief of the Castle Island, NC field school and as interim DSO for the project.

RICHARD VIDUTIS, PH.D.
HISTORIAN

Richard Vidutis earned a Ph.D. in Folklore and Ethnographic Studies from Indiana University. He has been active in the field of folklore and historic preservation since 1975. Since joining Goodwin in 1999 as a Historian, Dr. Vidutis has served as a historic preservation specialist. He has conducted literature searches for Phase I and II maritime and terrestrial archeological surveys for projects in Maryland, Virginia, Alabama, Mississippi, Louisiana, Florida and New York. He has extensive experience in researching local primary documents, in doing site evaluations, and in interviewing informants to support archeological and architectural documentation projects. He has co-authored integrated cultural resources management plans, and provided historic background research for cultural resources projects. Since he has been with Goodwin and Associates, Dr. Vidutis has authored historical and maritime contexts for 14 maritime projects.

As a private consultant Dr. Vidutis has worked for the National Park Service, Washington, D.C.; American Folklife Center, Library of Congress; Bureau of Historic Preservation, Tallahassee; Engineering-Science, Fairfax, Virginia; Greenhorn and O'Mara, Geenbelt, Maryland; 3D/International Environmental Group, Cincinnati; Pennsylvania Heritage Affairs Commission, Harrisburg; Urban Traditions, Chicago; Superior Restorations, Whitewater, Wisconsin; Airmen Memorial Museum, Suitland, Maryland; Michigan State University Museum, East Lansing; Folklore Institute, Indiana University, Bloomington; Semiotics Center, Indiana University, Bloomington; and with the Hungarian Ethnographic Institute, Budapest.

Dr. Vidutis has received research fellowships to Helsinki University, Adam Mickiewicz University, Poland, Vilnius University, Lithuania, and the University of Minnesota, St. Paul. He has also studied archiving at Wayne State University.

CARRIE E. SOWDEN, B.S.
NAUTICAL ARCHEOLOGIST II

Ms. Carrie Sowden received a Bachelor of Science degree from Emory University where she studied Chemistry with a minor in History. She held an internship at the University of Maine, Darling Marine Center as an historical / archaeological intern. While there she started and maintained artifacts for conservation from an underwater site as well as participated in phase II project for the *Angel Gabrial*. She is an Advanced SCUBA diver with Divemaster training.

Since joining R. Christopher Goodwin & Associates, Inc. in January, 2000, Ms. Sowden has been involved with marine artifact conservation and nautical data analysis.